1959
Luna 1-3
Solar Wind &
Plasmapause
discovery

beep..
beep..
beep..
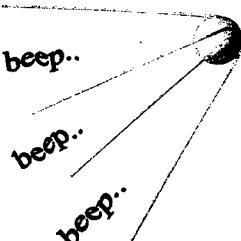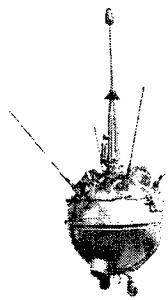
1957
Sputnik 1, transmitter

Professor Konstantin I. Gringauz
80-th anniversary

International Symposium

Space Plasma Studies
by In-Situ and Remote Measurements

Book of Abstracts

Space Research Institute of the Russian Academy of
Sciences

Moscow, June 1-5, 1998

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 9 June 1998	3. REPORT TYPE AND DATES COVERED Conference Proceedings

4. TITLE AND SUBTITLE Space Plasma Studies by In-Situ and Remote Measurements	5. FUNDING NUMBERS F61775-98-WE075
6. AUTHOR(S) Conference Committee	

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Space Research Institute of the Russian Academy of Sciences Profsoyuznaya 84/32 Moscow 117810 Russia	8. PERFORMING ORGANIZATION REPORT NUMBER N/A

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) EOARD PSC 802 BOX 14 FPO 09499-0200	10. SPONSORING/MONITORING AGENCY REPORT NUMBER CSP 98-1048

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.	12b. DISTRIBUTION CODE A

13. ABSTRACT (Maximum 200 words)

The Final Proceedings for International Symposium on Space Plasma Studies, 1 June 1998 - 5 June 1998

This is an interdisciplinary conference. Topics include physical processes in the solar wind and in the magnetosphere.

14. SUBJECT TERMS Space Science, Ionosphere, Plasma Physics			15. NUMBER OF PAGES 85
			16. PRICE CODE N/A

17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18
298-102

Professor Konstantin Iosiphovich Gringauz milestones

1918, July 5	Born in Tula, Russia
1921	Moved to Samara/Volga river where attended school, became radio amateur
1935	Enrolled educational Electrotechnical Institute, St.-Petersburg
1941	Diploma in frequency modulation, then new brand, continuation work in Radiotechnical laboratory (since 1940)
1942	Winter – evacuated to Moscow from city blockaded by Germans Summer – work in Belowo city/Syberia for production of tank's radio transmitters and receivers
1944	Studies of effectiveness of radio tank communications in battlefield conditions, Poland Passed entry exams for postgraduate studies
1945	Position in classified radio institute, postgraduate studies of radio wave propagation in the ionosphere
1947	Moved to a Laboratory for radio-Wave propagation in Korolev's new Bureau for Rocket Development
1948	Participating in launching V2 rocket with radio sounder
1949	Gained his PhD, in charge of Laboratory for radio technology
1952-1958	Ionosphere measurements by UHF waves radiated from Geophysical rockets, first information on the slow decrease of electron density above F_2 layer
1957	Participation in the launching of the first SPUTNIK (in charge of BEEP-BEEP transmitter)
1958	First in-situ studies of the upper ionosphere and its irregularities from SPUTNIK 3 geophysical observatory
1959-1960	Participation in research aboard the first LUNA 1-3 spacecraft. Discovery of the Earth's plasmasphere. Correction of Van Allen's estimations of particle flux in the Van Allen Belts. First observations of the 'Solar Wind'.
1960	Awarded by Lenin Prize (highest in USSR).
1962	Plasma experiments aboard KOSMOS 2, evidence of the lack of charged particles thermodynamic equilibrium in the ionosphere.
1964	Experiments aboard the first Moon orbiter LUNA 4, evidence of geomagnetic tail existence downstream to lunar orbit.

1967- 1976	Plasma experiments aboard VENERA 4,6 landers and the first Venusian VENERA 9,10 orbiters. Discovery of origin of the mysterious night-time ionosphere of Venus.
1970- 1979	Ionospheric experiments aboard COSMOS 378, INTERCOSMOS 8,10,12,14,18,19 and KOSMOS 900.
1970- 1981	Series of in-situ plasma experiments aboard VERTICAL 1-5,7,10 rockets.
1971- 1973	Participation in the discovery of the Martian magnetosphere from the first Martian orbiters MARS 2,3,5.
1972- 1984	Solar wind and magnetosphere plasma experiments aboard high apogee PROGNOZ 1-7,9 orbiters
1982- 1986	Design and implementation of plasma experiments aboard the Halley's comet probes VEGA 1,2. Discovery of previously unknown cometary plasma structures - the "cometosheath" and "cometopause".
1986	Award of State Prize of USSR for scientific achievements.
1988	Experiments aboard PHOBOS mission. Authorship of paper with first public criticism of the Soviet space program. COSPAR award for outstanding contribution to space research.
1989- 1993, June 10	Continuation of the analysis of VEGA and PHOBOS mission results. Preparation of experiments for the Mars 96 mission.

MARS MAGNETIC FIELD: DISCOVERY OF PALEOMAGNETIC FIELDS DUE TO CRUSTAL REMNANCE

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The Mars Global Surveyor was placed into a highly elliptical orbit on Sept. 12, 1997 with periapsis below 200 km. The MAG/ER investigation provides vector measurements of the magnetic field and the ionospheric electron density near periapsis. The instrumentation includes twin fluxgate magnetometers mounted at the ends of the diametrically positioned and separately articulated solar panels. The most surprising result is the discovery of localized magnetic fields of planetary origin, presumably due to remnant crustal magnetization. Maximum fields measured while below the ionosphere at altitudes between 105-120 km exceed 300 nT. We present an initial survey of these very localized fields, their variations and extrapolations to the Martian surface and correlate them with the local Martian topography and "geology". We also report on their role in the deflection of the solar wind and the development of the detached Martian bow shock wave and magnetosheath in the interaction with the solar wind.

THERMAL PLASMA MEASUREMENTS IN MAGNETOSPHERE IN THE INTERBALL AURORAL PROBE MISSION

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Electron temperature of cold plasma was measured by floating probe modification of Langmuir probe (experiment KM-7) onboard Auroral Probe of INTERBALL mission since August 31, 1996 - first switch on after launch - up to present time. About 70% of time the spacecraft was outside

plasmasphere - in polar magnetosphere at heights up to 20000 km due to the orbit configuration. The spatial and temporal behavior of· electron temperature of magnetospheric cold plasma are described and discussed.

SATELLITE AND GROUND-BASED MEASUREMENTS OF THE SAR-ARC PHENOMENA

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Data of an AKTIVNYI satellite and the ground-based complex optical and ionospheric measurements in the region of the SAR-arc are presented. Photometric observations were carried out at the Maimaga station (invariant latitude Λ=56.5°, geomagnetic longitude λ_m=200°) and vertical incidence ionospheric soundings were made at Yakutsk (Λ=55.6°, λ_m=200°) and Zhigansk (Λ=60.4°, λ_m=195°) stations. By optical and ionospheric measurements from Yakutsk and Zhigansk it is shown that when SAR-arc arises for the interval less than 15 min, the local minimum of the F-region electron density is formed, and in the ionograms typical signatures of the polarization jet or SAID are observed. Simultaneously, the height of the regular F_2 layer increases. This evidences that strong electric field (E $\approx$ 100 mV/m) exists at the F_2 layer heights. In this case, in addition to the SAR-arc energy sources, the effect of the ion-frictional heating is turned out to be important. Local minimum of the electron density, observed during several hours after midnight, coincides with the SAR-arc location. Simultaneous measurements aboard the Aktivnyi satellite at the altitudes ~500÷800 km above the SAR-arc also show 3÷10 times decreased electron density. At altitudes of 1000÷2000 km the electron density can slightly increase or stay at its usual level. The electron temperature elevates up to 4000÷5000K.

A MODEL OF DISTURBED MAGNETOSPHERE

I.I. Alexeev

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Previous paraboloid magnetospheric model is presented in a new form allowing to describe and analyze the magnetospheric disturbances. Tail lobe magnetic flux value F_{pc} is introduced. as input parameter of magnetospheric model. Model key parameters and ground state of the magnetosphere are determined. Time variation of tail currents and ring currents during substorms and storm describes dynamics of the magnetosphere. The ring currents and tail currents are considered as alternative possibilities for energy storage and its father release during recovery phase. When substorm and storm activity absent, field-aligned currents directly transfer input solar wind energy to the upper atmosphere. If this channel of the energy transport is not enough, the substorm activity occurs and it gives the main contribution to the energy transfer to the ionosphere. If the energy input is so much that the ring current injection occurs, the magnetic storm storages energy and transfers it to the middle latitude ionosphere. The previous magnetospheric state and solar wind conditions determine an amount of energy which is transferred by each of the above mentioned models. Experimental evidence and model simulations are reviewed for each energy transfer process by case study.

PLASMASPHERIC AND MAGNETOSPHERIC ELECTRON DENSITIES DETERMINED FROM ISEE AND CRRES PLASMA WAVE OBSERVATIONS

Roger R. Anderson [1], J. Douglas Menietti [1], Robert W. Lane [1], Mark D. Brown [1], Mark B. Moldwin [2], Hamid K. Rassoul [2], Paul Douglas [2], Donald L. Carpenter [3], and Michelle F. Thomsen [4]

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In its nearly ten-year life following its launch on October 22, 1977, the International Sun Earth Explorer 1 (ISEE 1) with its 22.6 R_e geocentric apogee, 700 km perigee altitude, and 30° inclination, made two passes. one outbound and one inbound. through the plasmasphere and magnetosphere every 57 hours. The Combined Release and Radiation Effects Satellite (CRRES), during its 15-month life after its launch on July 25, 1990, into a 6.3 R_e geocentric apogee, 350 km perigee altitude, 18° inclination orbit, made an outbound and inbound pass through the plasmasphere and magnetosphere every 10 hours. The ISEE 1 Plasma Wave Investigation (PWI) included a Sweep Frequency Receiver (SFR) that swept the frequency range from 100 Hz to 400 kHz every 32 seconds. The CRRES Plasma Wave Experiment (PWE) included a SFR that swept the frequency range from 100 Hz to 800 Hz every 32 seconds, the range from 800 Hz to 6.4 kHz every 16 seconds, and the range from 6.4 kHz to 400 kHz every eight seconds. Both these receivers provided measurements of the total electron density up to 2000 electrons/cc independent of spacecraft charging. Beyond the plasmapause in the outer magnetosphere the density was determined from the lower cutoff of the trapped continuum radiation at the local plasma frequency F_{pe} using the relation $F_{pe} = 8.98\sqrt{N_e(\text{cm}^{-3})}$ kHz, where N_e is the electron density. Within the plasmasphere, emissions detected at the Upper Hybrid Resonance frequency F_{uhr} were used to determine N_e via the relation $F_{uhr}^2 = F_{pe}^2 + F_{ce}^2$ where the electron cyclotron frequency $F_{ce} = 28|B(\text{nT})|$ Hz. CRRES tended to cover the Earth's near-equatorial and low-latitude plasmasphere and magnetosphere out to geosynchronous orbit. The ISEE 1 measurements primarily covered the mid-latitude region. These two spacecraft provided a comprehensive survey of the electron density in the magnetosphere as a function of location, time, and geomagnetic activity that are valuable data for generating and testing models of plasma dynamics. In analyzing the data, much variability and structure were observed frequently in the plasmasphere and magnetosphere, especially near the plasmapause. During geomagnetically active times multiple plasmapauses were often observed. The location of the plasmapause and the density profiles within the plasmasphere determined by these ISEE 1 and CRRES measurements as a function of local time and geomagnetic activity will be presented and compared with results acquired from other satellite and ground measurements.

A MODEL OF THE SPATIO-TEMPORAL STRUCTURE OF THE SUBSTORM ELECTROMAGNETIC DISTURBANCE AND ITS CONSEQUENCES

A.E. Antonova, Yu. Gubar', and A.P. Kropotkin

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In the outer quasi-dipole zone of the magnetosphere, transverse-small-scale standing Alfven waves form resonant response in that zone to the nonresonant disturbances penetrating there from the geomagnetic tail during substorm activations. The short-lived source acting in the relatively narrow L interval is supposed. It is located in the nightside sector, in the vicinity of the boundary between taillike and dipole-like field lines. The resonant waves are Alfven field-line oscillations with a continuous frequency spectrum. During their radial propagation between the poloidal and toroidal resonant surfaces, different spectral components phase mix; this produces a fast decrease of the resulting disturbance amplitude. The original theory by Leonovich and Mazur is generalized to take into account these effects due to non-monochromatic and nonuniform features of the source disturbance. Analytical approach provides asymptotic estimates of the resonant response time-scale as dependent on those source features. Preliminary numerical results for different models of the source will be presented also. The model should provide an adequate three-dimensional spatio-temporal pattern of intense electromagnetic disturbances in the nightside magnetosphere, which are associated with substorm activations and are observed as time-dependent substorm current wedges and pulsations Pi_2.

Another application of the theory is connected with intense short-term induction electric field due to the resonant disturbance. This should act as a mechanism of acceleration for energetic particles, in particular for relativistic electrons.

Relativistic Electrons (RE) in the magnetosphere are considered as an important constituent of the radiation environment which presumably may couple the activity in the solar-terrestrial system to the atmospheric processes, e.g. by means of influence upon the mesospheric ozone abundancies. However the origin of RE sporadic fluxes remains rather enigmatic.

Consequences for the RE acceleration of the Alfven resonant electromagnetic pulses during substorms will be numerically analyzed and discussed with comparison to observational data.

ENERGETIC PARTICLE POPULATION IN THE HIGH-LATITUDE GEOMAGNETOSPHERE · ·

A.E. Antonova, and A.P. Kropotkin

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In accordance with model concept and quantitative estimates (V.P. Shabansky and A.E.Antonova, 1968; V.P. Shabansky, 1975), energetic particle structures and dynamics in the Earth's high-latitude dayside magnetosphere are determined by nondipolar magnetic field behavior, especially by off-equatorial field minima, existing on both closed and open field lines, and are greatly affected by the magnetopause proximity.
Energetic particle enhancement in the high-latitude traps was observed on the PROGNOZ 3 and 7 spacecraft (Antonova and Nikolaeva 1979; Antonova et al., 1984). Additional confirmations have been obtained during PROGNOZ 9 passes through the dayside polar cusps and adjacent regions at high latitudes, both in the northern and southern hemispheres (Antonova et al., 1988; Antonova, 1991,1996). Energetic particle fluxes in the high-latitude magnetosphere greatly increase during active periods.
Recent observation of the confined energetic heavy ion population in the high-altitude, high-latitude regions onboard POLAR spacecraft (Chen et al., 1997) supports the model inferences.

INNER MAGNETOSPHERE CURRENTS AND ITS ROLE IN MAGNETOSPHERE DYNAMICS

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The role of inner magnetosphere currents in the magnetosphere dynamics is analyzed. It is suggested that when plasma bulk velocity is lower then Amper's and sound velocity the magnetostatic equilibrium condition is fulfilled. External source of magnetic field lead to change of magnetostatically equilibrium currents which give the possibility to explain IMF control of inner magnetospheric currents without introduction of reconnection processes as the cause of inner magnetosphere electric field and currents. The theory explains observed reconnection events on the

magnetopause and geomagnetic tail as the consequence of inner magnetosphere· current redistribution. The change of magnetopause position under the influence of inner magnetosphere magnetic field sources is analyzed. It is shown that the main source of such change may be the effective eastward ring current flowing near the inner edge of plasma sheet. This current create negative equatorial magnetic field disturbance in the near tail region and can be considered as one of the main element of substorm dynamics explaining substorm beginning deep in the magnetosphere not far from geostationary orbit. The processes of Birkeland current wedge and auroral bulge formation are also analyzed.

MEDIUM SCALE MAGNETOSPHERIC TURBULENCE AND QUASI THREE-DIMENSIONAL PLASMA SHEET MODELING

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One of the main poorly investigated features of magnetospheric dynamics is the existence of medium (with the scales an order of magnitude lower then large-scale magnetosphere convection vortices) scale electrostatic vortexes. The typical example of such vortex is the electric fields of inverted V structure. Such vortexes exist in the conditions of magnetic field line nonequipotentiality and can produce effective plasma sheet mixing. The existence of such mixing lead to the development of quasi diffusion flux directed against plasma pressure gradients. The existence of quasi diffusion flux gives the possibility to solve Grad-Shafranov problem and to obtain the dependence of plasma pressure from the vector potential of the magnetic field. Obtained solutions are used for the quasi three-dimensional modeling of tail plasma distribution. The model give the possibility to describe plasma sheet thinning without compression, the formation of extremely thin current sheets, plasma sheet concave structure during southward IMF orientation and theta aurora formation during northward IMF orientation.

SPM - ION AND ELECTRON SPECTROMETERS FOR ROLAND/ROSETTA MISSION

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The Small Plasma Monitor (SPM) instrument as a part of the plasma package (ROMAP) will be applied on the Lander for the ROSETTA Mission. This instrument which includes two ion and one electron energy spectrometer is designed for investigation of comet (Wirtanen) - solar wind interaction during large scale comet activity phases (from 3 AU to 1 AU).

The instrument is able to determine the major solar wind parameters, as density, speed, ion -and electron temperature and flow direction, p/α-particle ratio, and charging of the comet and the Lander relative to the local interplanetery electric potential. In addition, it will measure the energy spectrum of photo-electrons and ions of cometary origin picked up by solar wind and returned to the nucleus.

.Despite the very strong restriction on size and mass ($\sim$ 10×10×8cm; 120g) the sensitivity and resolution of the sensor are high ($\Delta E / E \sim$ 4 % - for ions; $\sim$ 10 % - for electrons) and its field of view is wide (~120°×120° for each ion analyser). The E/q - range extends to 12 keV and 6 keV for ions and electrons correspondingly.

LONGTERM CHANGES OF COSMIC RAY INTENSITY: SPECTRAL BEHAVIOUR AND 27–DAY VARIATIONS

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The temporal scaling properties of the cosmic ray intensity (climax neutron monitor data) are examined with use of the set of techniques (localized spectral analysis on the base of wavelet transform was among them) to analyze these and closely connected data and to examine their properties. The power density of cosmic ray variations with characteristic time about of days and months, which changes in phase with solar activity, undergoes the temporal depressions during the periods of the solar magnetic field reversals. The strength of the interplanetary magnetic field was also diminished during the same periods.

ROMA - AN EXAMPLE OF A NEW GENERATION OF FLUXGATE MAGNETOMETER FOR SPACE APPLICATION.

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Germany

A new type of fluxgate magnetometer will be applied in space at first time during the ROSETTA Mission. This magnetometer is based on a digital electronics design, which has been developed since 1995 and tested already on ground in several observatories. The substitution of analogue components by using fast algorithms has a large number of advantages especially in space applications. Low weight, wide measurement range, a power consumption that depends on the data rate, robustness, reliability

and the high flexibility are the main arguments for space application. Thus, the ROSETTA Lander magnetometer has an overall weight of less than 500 g (compared with more than 2 kg for the magnetometers on MARS 96 and EQUATOR S) without any loss of measurement quality. The paper will give an overview about the last results in this development.

ACCELERATION OF THE FAST SOLAR WIND

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The fast solar wind comprising of ions and electrons is modeled starting from the coronal base. The assumed heating by Alfven waves close to the base and over extended range results in a reasonable temperature profile from the corona to 1 AU. The acceleration of the solar wind is rapid; the speed of 500 km/s is already reached at several solar radii. A realistic model of the magnetic field near the Sun, with the current sheet (monopole) field as well as solar dipole and quadrupole terms is taken into account. We discuss several important issues: (i) temperature anisotrophy of the solar wind, (ii) wave temperature vs. kinetic temperature profile, (iii) efficiency of heating by the waves.

COMPLEX OF THE ALFA-3 INSTRUMENTATION FOR RESEARCH OF COLD PLASMA ION COMPONENTS IN THE EARTH'S MAGNETOSPHERE ON BOARD INTERBALL SATELLITES

L.M. Banduristy [1], **N.A. Barabanov** [1], V.V. Bezrukikh [2], Y.I. Venedictov [2], S.G. Dovgal [1], S.L. Yemelyanov [1], V.I. Zhdanov [2], V.P. Nokel [1], Y.S. Yampolsky [1]

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The complex ALFA-3 executes measurement of differential spectra of ions in range of energies from 0 to 25.5 eV. For measurements the retarding potential analyzers (RPA) of a type PL-19 and PL-48 are used. In an outcome of ground processing of the measured spectra the sizes of concentration, temperature, mass structure ionic components of cold plasma are determined.

Singularity of a complex is that the measurement of differential spectra of ions implements two ways: modulation way - with the help of special modulation sensor PL-19; and way of an instrument subtraction of references - with the help of integral sensor PL-48. It has allowed reducing influence of background interference and by that to increase a resolving power on a mass structure of ions.

For increase spatially of temporary-time sanction of measurements in conditions of small telemetry bit rate in a complex ALFA-3 the special measures are adopted, which number includes adaptive searching of a beginning of scan of retarding voltage of sensors.

Operation control of a complex and processing of the information executes the microcontroller, that has allowed to simplify a schematic realization, to increase a reliability, to facilitate debugging of algorithm of activity during development.

The outcomes of the complex ALFA-3 activity on board Tail and Auroral Probes of the INTERBALL project have shown efficiency of the applied solutions. The comparison of measurements with the help of different RPAs PL-19 and PL-48 shows their correlation and practically identical accuracy, though the speed of measurements for the sensor PL-48 was in 4 times above.

SPACECRAFT POTENTIAL MEASUREMENTS BASED ON
INTERCOSMOS-BULGARIA 1300 DATA

N.G. Bankov [1], G.L. Gdalevich [2], G.A. Stanev [1], and **S.K. Chapkynov** [1]

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In a series of in-situ scientific investigations in space measurements are carried out relative to the potential of the spacecraft. Changes of this

potential influence on the normal functioning of scientific instruments, e.g. the probe ·instruments for plasma studies. When preparing the INTERCOSMOS-BULGARIA 1300 launch, special actions were taken to increase the equipotential conducting surface of the satellite. The behavior of the satellite surface potential changes was examined during the active life period of the satellite using the data of ion and electron sensors, electrostatic field measurements and ion drift measurements. For different levels of geomagnetic activity, the spacecraft potential variations along the daytime and nighttime parts of the orbit are revealed.

ELECTROSTATIC FIELD MEASUREMENT BY MEANS OF SPHERICAL ION TRAPS

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Peculiarities of the functioning of spherical ion traps intended for measurements aboard a satellite are considered. Using some definite assumptions about thermal velocity values of ions and electrons and the particle collection radius of spherical ion traps, an expression for floating potentials of outer grids was obtained. The influence of the outer grid perforation was taken into account as the geometrical transparency factor. The dependence of the final result on Debye radius and the plasma ion mass number was investigated. It is shown that the above mentioned expression is a generalized one for the potential of a sphere immersed into plasma. On the basis of this expression a conclusion is drawn that the spherical ion trap is possible to use for electrostatic field measurements.

CHARACTERISTICS OF THE H ATOM POPULATIONS IN THE PROBLEM OF THE SOLAR WIND (SW) INTERACTION WITH THE LOCAL INTERSTELLAR MEDIUM (LISM)

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There is presently consensus that the LISM contains mainly a partially ionized hydrogen gas (electrons and protons or the plasma component, and neutral H atoms) which moves with the supersonic velocity (the bulk velocity is more than the sound one) relative to the Sun. The self-consistent axisymmetric model of the SW interaction with the LISM taking into account mutual influence of plasma component and neutral H atoms was constructed by Baranov and Malama (J. Geophys. Res., **98**, No.A9, 1993). They used the kinetic description of H atoms motion together with the hydrodynamic approximation for plasma component. Four populations of H atoms are formed in the problem considered: 1) primary H atoms of the LISM's origin moving into the solar system, 2) secondary H atoms which are born due to the resonance charge exchange with the LISM's protons, 3) the fast SW hydrogen atoms formed due to the charge exchanges of the solar wind protons in the preshock region of the termination shock (TS), and 4) the fast SW hydrogen atoms formed in the charge exchange of the thermalized solar wind protons (the postshock region of the TS).

It is demonstrated that the distribution functions of the all H atom populations are essentially not Maxwellian. The distributions of H atom parameters (the bulk velocity, number density, and "temperature") as a function on the distance from the Sun and on the angle from the upwind direction are analyzed. Some experimental data confirming the theoretical predictions are presented.

GENERATION OF MAGNETIC FIELD NEAR THE MAGNETOPAUSE OF RAPIDLY ROTATING PLANET

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·If conductivities of the ionosphere and magnetopause of rapidly rotating planet are large (but less than the field-aligned conductivity), the rotation on a bundle of open field lines can approach the magnetopause. Due to the differential rotation the azimuthal magnetic field can be generated from the meridional magnetic field of the solar wind flowing past the magnetosphere of rapidly rotating planet. Violation of the axial symmetry with respect to the planet rotation axis for the velocity field and the magnetic field of a flux flowing past create necessary conditions for generation of enhanced. meridional magnetic field of the solar wind. This mechanism can operate as hydrodynamic dynamo.

COLD ION FLUXES IN THE EARTH'S MAGNETOSPHERE MEASURED ON BOARD THE TAIL AND AURORAL INTERBALL PROBES

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Wide angle electrostatic ion analyzers were installed on board the Tail and Auroral INTERBALL probes to measure characteristics of cold plasma in the Earth's magnetosphere. The density and temperature of ions in the plasmasphere obtained by both of the satellites are presented and discussed. The dependence of the plsamapause location on the level of geomagnetic activity is analyzed. The results of cold plasma parameter measurements in INTERBALL mission are compared with results of other experiments.

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ON POSSIBLE OBSERVATIONAL EVIDENCE IN ELECTRON DENSITY PROFILES OF A MAGNETIC FIELD IN THE MARTIAN IONOSPHERE

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The slopes of the topside electron density profiles and their variations with solar zenith angle and solar wind dynamic pressure in the ionosphere of nonmagnetic or weakly magnetized planet can reveal properties associated with the presence of a magnetic field in the ionosphere and even the origin of this field. The data on the Martian ionosphere obtained by several previous missions are clear evidence for different dynamical behavior of both ionosphere, the Martian and Venusian ones, as well as for permanent participation of a global magnetic field in the formation of the Martian ionosphere. However, recent results of the Mars-Global-Surveyor spacecraft show that the possible existence of a sufficiently strong global magnetic field can no longer be supported and that Mars should be similar to Venus in the solar wind interaction process. These apparent controversies will be discussed in the paper.

MORPHOLOGICAL FEATURES OF WIDE-BAND RADIO FREQUENCY NOISE IN THE UPPER IONOSPHERE

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The electromagnetic radiation in the upper ionosphere is investigated since the first artificial satellite launch and is useful as diagnostic tool of near-Earth plasma. For example, this radiation is used for an estimation of the ionospheric local electron density, the maximum electron density of the

ionospheric F_2 layer. In present paper the observed morphological features of the upper ionosphere broadband noise in 0,1-10 (30) MHz frequency band are investigated using data of low altitude satellites APEX and KORONAS-I, correspondingly. The global distribution features of wide-band emissions are revealed. They manifest as remarkable increase of noise spectral density over Euro-Asian longitudinal sector. The obtained pattern of the global distribution of broadband noise during the night time period in the upper ionosphere agrees with the available theoretical calculations of the energy flux density distribution from the ground based broadcasting stations for the sunlit conditions in the lower ionosphere. The energy-angular distribution spectra observations of the energetic ions simultaneously with the wave observations are shown that during the broadband emission occurrence are observed the ion conics.

GENERATION OF ELECTROSTATIC NONLINEAR WAVE STRUCTURES

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Recent satellite observations have shown that most of the broadband electrostatic noise (BEN) waveforms measured in the Earth's magnetotail, as well as in the auroral region, consist of a series of isolated spiky pulses. Sometimes they appear in a doublet form or the BEN waveforms composed of quasi-periodic waves. The investigation of nonlinear evolution of the electron acoustic instability driven by warm ion or electron beams has shown that it could result in the formation of solitary and periodic nonlinear electrostatic wave structures. A prerequisite to their formation is determined by the particular type of the wave number dependence of the growth rate. The generation of nonlinear wave structures was studied in relation to the wave number dependence of the growth rate and for different types of initial conditions. The amplitudes of the obtained electrostatic nonlinear structures are of the order of experimentally observed.

ELECTRODYNAMICS OF THE POLAR SOLAR WIND

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Collisional damping of the Alfven waves propagating away from the Sun in
the solar corona is considered. It is shown that the damping is maximal in
regions where the wave frequency is near to the frequency of ion-ion
collisions. The optical depth for the Alfven waves with periods about 5 min
is of order of unity. The spatial distribution of the Alfven coronal heating
source is discussed. It is shown that the heating source power has a
maximum at heliocentric distances about 1.5 solar radii, and the typical
width of the energy release localization is of order of 0.1 solar radii.

STUDY OF THE INNER MAGNETOSPHERE BY THE LIULIN INSTRUMENT ONBOARD THE MIR SPACE STATION

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The Bulgarian-Russian dosimeter-radiometer LIULIN was installed in the
working compartment of the MIR space station. The effective mass
thickness of shielding matter inside the working compartment of MIR is
evaluated to be 6-15g/cm^2 that is why the main contribution to the dose
rate is given by protons and electrons that outside MIR space station have
energy large than 100 MeV and 10 MeV respectively. LIULIN
measurements were carried out under a wide variety of solar and
geomagnetic activity conditions in 1989-1994 time period. They provide an
excellent opportunity to study long term effects on the dose-rates and on
the dynamics of the radiation belts over long time periods, as well as rapid

changes, induced by solar proton events and geomagnetic disturbances. In the LIULIN data up to three maximums were observed in the inner magnetosphere, the main, the new and the second maximums. The main maximum is situated in the SAA at L=1.3-1.5. This maximum is observed always and consists mainly by protons. The dose rate varies by an order of magnitude from 200 to 2000 mGy/hour dependent of the altitude, UT, solar cycle and time after SPE. The flux varies in the interval of $30 \div 120$ particles$\cdot$cm$^{-2}\cdot$s^{-1}. Major changes of the main maximum together with the appearance of two additional maximums occurred after the SPEs of 22 March 1991, 14 June 1991 and 20 June 1991. After the SPE on 17 June 1991 the main maximum rose up by a factor of two and decayed again until 30 June 1991. The second maximum is not so stable like the main and is located at L = 3. It was intensified after some of the SPEs during the period (19 October 1989, 22 March 1991, 15 June 1991 and 20 February 1994). The dose rate in it varied by a factor of 2 from 8 to 16 mGy/h. The flux varies between 0.8 and 12 particles$\cdot$cm$^{-2}\cdot$s^{-1}. The dominant particles in the second maximum are protons close after the SPE and electrons later. The second maximum decayed in a few months. For example after the SPE on 22 March 1991, it disappeared completely until 15 May The new maximum was created after the SPE on 22 March 1991 and SSC on 24.03.91, and was located between the main and the second maximums at L = $1.8 \div 2.2$. After the solar-terrestrial disturbances in June 1991, and especially after the SPE on 17 June 1991, it was remarkable intensified. When it was first created it was completely separated by the main, and the predominant particles were protons. Later in June it moves toward the main maximum and the predominant particles in it are protons on the westbound side (side to the main) and electrons on the eastbound side. The dose rate in it varied by factor of 12.5 from 8 to 200 mGy/hour. The flux varied between 0.8 and 30 particles$\cdot$cm$^{-2}\cdot$s^{-1}. the new maximum decayed toward the main from June 1991 until middle of 1993. The presence of solar particles in the vicinity of the Earth is found to be a necessary but not sufficient condition for creation of a new maximum in the distribution of flux in the inner magnetosphere. Remarkable effects seen in the inner magnetosphere only when a large magnetic storm begins immediately after the beginning of SPE.

IONOSPHERE F-REGION AS AN INDICATOR OF THE EVOLUTION OF ATMOSPHERIC GRAVITY WAVES IN HORIZONTAL SHEAR FLOW

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The ambipolar diffusion equation for the height distribution of electron density at the ionosphere F2-layer is solved by using Green's function. This non-stationary solution allows investigating the reaction of electron density on the propagation of the modified atmospheric gravity waves. The time varying frequencies of these waves and their amplitude amplification/damping rates is due to the presence of the horizontal shear flow. The difference as well as the coupling between the gravity and shear waves is considered on the base of the obtained height profile of electron density.

ARTIFICIAL NEURAL NETWORK 3-D MODEL OF THE DAYSIDE MAGNETOPAUSE

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Empirical model of the dayside magnetopause was developed by means of artificial neural network package 'Neuro Shell-2'. The hour-averaged measurements of solar wind plasma and interplanetary magnetic field (IMF) are used as model parameters. The studies of relative importance of individual solar wind variables as well as different coupling functions were made. The model permits to investigate the complicated shape of the magnetopause as function of the four external parameters (solar wind velocity, density, Y- and Z- components of IMF).

ESTIMATION OF THE POSSIBILITY OF ELECTROMAGNETIC SOUNDING METHOD FOR BOW SHOCK WAVE GLOBAL MONITORING

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Imaging of large-scale structures in space plasma is a new exciting opportunity to study solar-terrestrial interaction. Remote electromagnetic (EM) sounding seems to be the unique method that can allow investigating the structure and dynamics of such near - Earth formations as bow shock, magnetopause, plasmasphere and other magnetospheric boundaries. As an example the feasibility of Earth's bow shock EM sounding from outer space is discussed. Since the electron plasma density of solar wind and bow shock is within the limits of 1-500 electrons per cm^3, so for reconstruction of electron density profiles sounder must operate in the frequency band about 9-200 kHz, i.e. practically in very low frequency (VLF) range. In order to obtain the information from large bow shock areas the spacecraft has to be located at a distance not less than 25-30 Earth radii from ramp. Necessity to generate EM waves in VLF range and large distance between spacecraft and target lead to considerable technical difficulties for realization of EM sounding. The developed theory of operation of VLF sounder in rarefied plasma and detailed calculations of hardware implementation allowed to propose the system which may measure the co-ordinates, electron densities and velocities of sounded boundaries movement. The average transmitter active power required about 20 W only at maximal antenna length about 3 km and weight about 100 kg.

AN EXACT SOLUTION OF THREE-DIMENSIONAL DYNAMO-EFFECT
PROBLEM IN EXPANDING PLASMA BALL BASED ON USING THE
GENERALIZED SPHERICAL FUNCTIONS

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Consideration of the dynamo effect in the expanding ball with strongly
anisotropic conductivity is of importance in modeling the experiments on
artificial plasma injection into the earth's ionosphere and magnetosphere.
Previously used approaches for solving this problem were based either on
(i) reduction of the respective equations to a quasi-two-dimensional form
by the assumption of infinite longitudinal conductivity or (ii) the use of
numerical methods to carry out calculations for the case of a realistic
three-dimensional geometry.
We put forward an analytic method that can give exact solutions of the
dynamo-effect equations for the case of three-dimensional geometric
configuration and arbitrary values of plasma conductivities. This approach
is based on using the generalized spherical functions, whose theory was
developed in our study. Despite their quite sophisticated form, the
generalized spherical functions possess, in fact, exactly the same
properties as well-known Legendre polynomials and can be applied to
solving the dynamo-effect equations with the same efficiency as ordinary
spherical functions are used to solve Laplace equation.

TRANSITION OF PLASMA INTO A STRONGLY-COUPLED STATE AS A
POSSIBLE REASON FOR ANOMALOUS RESISTANCE IN ACTIVE
SPACE EXPERIMENTS

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A well-known phenomenon in the experiments on plasma injection in space is an appearance of anomalous electric resistance, which is usually attributed to the plasma turbulence. As was shown in our study, there may be yet another reason for this effect, namely, transition of plasma into a strongly coupled state in the process of its adiabatic expansion in vacuum. Since the kinetic energy of plasma decreases more rapidly than Coulomb energy, most electrons turn out to be quasi-localized in the vicinity of nearby ions. As a result, the electric current can be transferred only by a relatively small part of electrons, corresponding to the high-energy tail of the distribution function. Concentration of free charge carriers, calculated in our study, turns out to be independent of the plasma temperature and determined only by its density. (These features are somewhat similar, from the formal point of view, to the properties of degenerate Fermi gas.)

ALFVEN WAVES IN THE SOLAR CORONA ACCORDING TO TWO-STATION FARADAY ROTATION OBSERVATIONS

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Cross-correlation analysis of the Faraday rotation fluctuations (FRF) of the Helios-1 linearly-polarized signals, recorded at widely spaced ground stations near Goldstone and Canberra showed that in the solar corona can exist Alfven waves which propagate both from the Sun and toward the Sun. The cross-correlation functions of the FRF change continuously in time and can have single maximum or two equal in value maxima, which correspond to Alfven waves propagating in the opposite directions.
Using an approximation of the thin screen we calculated the cross-correlation functions of the FRF for the power-law spatial spectrum of the magnetic field fluctuations. A comparison of the experimental data and theoretic expression shows that the form variability of the cross-correlation functions can be explained by the variations of the Alfven waves intensity. This result provides a possibility to estimate the velocity of Alfven waves and intensity of the coronal magnetic field.

AN INVESTIGATION OF THE STRUCTURE OF CORONAL STREAMER BELTS AND THE HELIOSPHERIC PLASMA SHEET AT THE EARTH'S ORBIT

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It is shown that the brightness distribution along streamer belts is nonuniform (the degree of nonuniformity about 10 ÷ 50 %). The distribution constitutes a sequence of coronal streamers, each of which at distances R > 3R$_\odot$ from the solar center has the cross-section with a typical angular size along the belt about 10 ÷ 50° and across the belt 10 ÷ 30° and is separated from its neighboring streamer by 10 ÷ 70°. A case study of CR 1591 and 1592 has shown that, in the absence of coronal mass ejection effects, the streamer distribution along the streamer belt can remain constant during nearly two Carrington rotations. The structure of the streamer belts remains almost unchanged in the heliospheric plasma sheet as far as the Earth's orbit.

EXTREME-ULTRAVIOLET RADIATION DIAGNOSTIC OF PICK-UP ION PHASE SPACE DIFFUSION CLOSE TO THE SUN

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Recent investigations of pick-up ion data obtained with the AMPTE and Ulysses spacecraft demonstrated that, in contrast to previous expectation, pick-up ion velocity distributions often are anisotropic. Such anisotropy implies pitch-angle scattering to be less efficient than usually assumed and translates into scattering mean free paths longer than those previously attributed to these particles, corresponding observations could give valuable insights into the details of the scattering process. We demonstrate that existing and forthcoming in-situ plasma observations can be supplemented with Earth-bound observations of the extreme ultra-violet resonance glow of pick-up ions in vicinity of the sun, mainly He$^+$ ions. The proposed observations, in combination with a theory of ions being picked-

up by the heliospheric magnetic field close to the sun will not only allow us to obtain information about the anisotropy· of the pick-up ion velocity · distributions, but also about the coronal magnetic field configuration as well as the acceleration of the solar wind. Therefore, such observations will contribute to an improvement of our understanding of the physics of the solar corona.

STRUCTURE AND PROPERTIES OF EXTERNAL CUSP/ENTRY LAYER UNDER DIFFERENT ORIENTATION OF INTERPLANETARY MAGNETIC FIELD

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INTERBALL-Tail is the only modern satellite crossing the region of "entry layer", where cusp field lines enter the magnetopause. More than 20 crossings of this region under different interplanetary conditions give information about structure of the "entry layer". In most cases the behavior of ion fluxes there can be explained with reconnection model. The comparison with simulation of ion distribution function in this region generated by reconnection was made. The attempt to distinguish the cases with clear reconnection sign and ones with turbulent interaction of draping magnetosheath plasma and magnetospheric field was made as well.

It was shown that in many cases, the population of boundary layer in the "throat" consists of "remained" part of particles precipitated into cusp. The entry layer plasma and plasma at lower altitudes inside cusp has to be strongly connected. The POLAR data was used to find the connection of entry layer with beneath located regions.

MAGNETOSPHERIC PLASMA PRESSURE OBTAINED FROM THE MAGNETIC DATA

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The magnetostatic equilibrium equation with the anisotropic pressure has been solved, the ratio of the transverse pressure to the parallel one being assumed to grow with the geocentric distance. The equation allows restoring the pressure up to some unknown function of the distance, which appears to be not too large. The empirical model of the magnetic field by Ostapenko et al. (Geomagn. & Aeronom., **36**, No.5, 35-42, 1996) plausible for the distances from 3 to 10 earth radii has been used. The model depends on D_{st}, K_p, and AE indices, as well as on IMF B_z and the solar wind dynamic pressure. The radial profile of the magnetospheric plasma pressure computed for quiet conditions is similar to that obtained from direct measurements. Influence of the five above-mentioned parameters on the profile has been studied. The total plasma energy content appeared to depend mainly on the solar wind dynamic pressure.

ON THE RELATION BETWEEN THE MOTION AND TIME-DEPENDENT STRUCTURE OF THE HELIOSPHERIC SHOCK AND THE ACCELERATION AND MODULATION OF ANOMALOUS COSMIC RAYS

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The structure of the heliosphere is time-dependent as a consequence of solar activity and various disturbances, which have shorter scales in time and space. In particular, the solar wind termination shock is expected to exhibit time variations in its location, structure and shape, all of which

influence the local acceleration and modulation of (anomalous) cosmic rays. Employing a self-consistent treatment of the interaction between solar wind plasma and cosmic rays that explicitly includes time variations due to solar activity and so-called global merged interaction regions, we first determine the location, motion and structure of the heliospheric shock as well as the simultaneous modulation of galactic and, in particular, anomalous cosmic rays in order to analyze inasmuch the latter can be used to obtain information about the shock. Second, using a standard transport model, we study the signatures of a three-dimensionally structured heliosphere on the spectra of anomalous cosmic rays with emphasis on their (helio-) longitudinal intensity gradients. With the full spectral information at our disposal, we identify the spectral regimes exhibiting the largest longitudinal gradients and discuss the potential of corresponding observations to contribute to our knowledge of the structure of the global heliosphere.

THE SOLAR WIND ACCELERATION BY DISSIPATION OF ALFVEN WAVES

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Axford and McKenzie (1992) suggested that the energy released in impulsive reconnection events ("microflares") generates high frequency Alfven waves with the period of the order of 1 second. The kinetic equation for spectral energy density of waves is derived in the random phase approximation. Solving this equation we find the wave spectrum with the power low "-1" in low frequency range which is matched to the Iroschnikov-Kreichnan spectrum above the spectral brake with the power low "-1.5". No fitting parameters are required for this. The heating rate of the solar wind protons due to the dissipation of Alfven waves is obtained.

PREBREAKUP AURORAL ARC: DOUBLE-SHEET CURRENT GENERATION IN THE NEAR-EARTH PLASMA SHEET, AND THE PROBLEM OF SUBSTORM ONSET

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Analysis of steady auroral arc-associated 3D current structures from the AUREOL-3 and ground-based data performed nearly 15 years ago led to the nested double sheet hierarchy (the "MATRESHKA Model"). To generate such a 3D hierarchical current structure a system of nested magnetic field minima in the near-Earth's neutral sheet is proposed. The field-aligned current is generated through the Grad-Vasyliunas-Bostrom-Tverskoy (GVBT) formula (vector product of the gradient of the specific magnetic flux volume, and the pressure gradient). The energy for the arc is taken from the thermal energy of the plasma sheet particles crossing the "arc's root" in the convection flow. Observational tests are discussed, and one such test is presented.

MEASUREMENTS FROM INTERBALL-2 AND MODELLING OF THE OUTER PLASMASPHERE REFILLING AFTER A LARGE MAGNETIC STORM

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Measurements from the INTERBALL-2 satellite allowed to observe the details of the plasmasphere refilling. Comprehensive data of thermal ion distribution functions for H^+, He^+ and O^+ were measured from the HYPERBOLOID multidirectional energy-mass-spectrometer both within and outside the plasmasphere. Electron densities are evaluated from the satellite potential in respect to plasma using RON and IESP-2 onboard instruments. The data show transition from the near-Maxwellian distributions within the plasmasphere at densities ≥ 100 per cc to bi-directional ion flows for H^+, and He^+ in the region of rapid decrease of

plasma density till values ~1 per cc above the diffuse auroral zone. The auroral plasma cavity above the auroral oval of discrete forms shows very low plasma densities in outflowing ions at altitudes 2-3 R_e. Model calculations from the CDPDM model are compared with the data and show reasonable agreement.

INVESTIGATION OF PLASMA DYNAMICS, WAVES AND ENERGETIC PARTICLES DURING GEOMAGNETIC STORMS ACCORDING TO "INTERCOSMOS-19" DATA

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The energetic electron streams and spectra (0.02 ÷ 2 MeV) and plasma density (10 ÷ 10^6 cm^{-3}) data were received with the help of INTERCOSMOS-19 satellite devices during strong magnetic storms in the Earth magnetosphere in March-April 1979. Behavior of this plasma, wave, and particle parameters at the middle and height latitudes at the different local time sectors are discussed.
Different movement of the plasma and wave boundary on one hand and energetic particle boundary on the other hand was revealed. So the plasma and wave observed boundary moves to the equator at the main phase but the energetic particle boundary moves to the pole. But at the recovery phase the plasma, wave and energetic particle boundaries move contrary the main phase. Analytical relation of plasma, wave and particle parameters was derived.

MODELING GRINGAUZ'S LEGACY FROM THE SOLAR WIND TO WEAKLY MAGNETIZED SOLAR SYSTEM BODIES

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Konstantin Gringauz made many discoveries in space plasmas ranging from the discovery of the plasmapause to the first in-situ detection of the solar wind, to the discovery of the plasma mantle of Venus, to the first detection of the cometopause at comet Halley. This talk is devoted to multiscale magnetohydrodynamic modeling of some of his favorite regions: the solar wind, the magnetospheres of Earth, Mars, and Venus, and the plasma environment of comets.

The basic tool used in the models is the new BATS-R-US (Block-Adaptive Tree Solar-wind Roe-type Upwind Scheme) code. BATS-R-US is a high-performance 3D AMR (adaptive mesh refinement) MHD code for space physics applications running on massively parallel supercomputers. In BATS-R-US the electromagnetic and fluid equations are solved with a high-resolution upwind numerical scheme in a tightly coupled manner. The code is very robust and it is capable of spanning a wide range of plasma parameters (such as plasma beta, acoustic and Alfvenic Mach numbers).

BATS-R-US is successfully used to simulate the inner solar wind from the base of the solar corona to well beyond Earth orbit, as well as the interaction of magnetospheres with the solar wind.

THE CONNECTION BETWEEN SOLAR WIND VELOCITY VARIATIONS AND THE DYNAMICS OF ENERGETIC ELECTRONS IN NEAR-EARTH SPACE.

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Many of the experimental data on energetic electron fluxes ($E_e = 0.04 \div 6.0$ Mev) in near-Earth space, obtained with a help of satellites of the PROGNOZ, COSMOS, RADUGA and INTERCOSMOS series, show that the energetic electron flux intensity in magnetosheath, magnetopause, outer and inner radiation belts depend on the solar wind velocity. For the

data on satellites PROGNOZ, MOLNIA and RADUGA analytical dependences for electron flux density J on the magnetosheath, magnetopause and outer radiation belt were obtained for the solar wind velocity $V(t)$: $J(t+\tau)=a+bV(t)$, where $\tau = 1 \div 1.5$ days for magnetosheath and magnetopause, $\tau = 2.5$ days for $L = 6.6$; t-time; a, b-coefficients, depending on position of satellite's region of space. The equation has been obtained which takes into account parameters of the solar wind and determines time for energetic electron transfer from the magnetospheric boundaries to ionospheric altitudes.

SELECTED RESULTS OF THE CELIAS - CHARGE, ELEMENT AND ISOTOPE ANALYSIS SYSTEM ONBOARD SOHO

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The CELIAS experiment onboard SOHO was designed to measure the mass, ion charge and energy of the low and high speed solar wind, of

suprathermal ions, and of low energy particles. Among pioneering results released after the CELIAS measurements one can indicate:

- detection in the solar wind of the single charged oxygen and carbon ions originating from Venus (CTOF sensor),
- revealing in the solar wind a number of elements/isotopes that was not ever observed (MTOF sensor), and
- detection of energetic (55÷85 keV) neutral hydrogen atoms of heliospheric origin (HSTOF sensor).

FILAMENT-GENERATED SOLAR WIND

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A new conception of solar wind plasma origin is presented. It is based on recent findings on a domination of sudden disappearing filaments {SDFs} as solar sources of interplanetary plasma density enhancements at 1 AU. We develop software, which shows how data on the SDFs and the solar magnetic field can be used to fit the real solar wind plasma density and velocity variations at 1 AU for flare-free solar-interplanetary magnetic sectors.

1997 HELIOSPHERIC SUBSTORMS

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Prominent (the most geoeffective) 1997 ISTP phenomena were considered. Their solar sources, MHD-structure, geometry, dynamics, and geoefficiency were identified, analysed, and estimated according to solar, interplanetary, and magnetospheric data of the near Earth spacecraft, and ground-based, observatories, which data are available on the Net. An especial attention was paid to heliospheric substorms: Jan. 9-12, Feb.27-

28, Apr. 16-17, May 15-16 - the interplanetary disturbances with three-phase dynamics and forward rotational discontinuities generated during interactions of filament-associated CMEs with the heliospheric current sheet. In this class of interplanetary disturbances forward rotational discontinuities arrive to the Earth's orbit long before the forward shock waves warning on forthcoming strong interplanetary and geomagnetic storm.

INTERSTELLAR ATOM FILTRATION IN THE HELIOSPHERIC INTERFACE: INFERENCES ON THE LIC ELECTRON DENSITY

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The solar system is moving through the partially ionized local interstellar cloud (LIC). The ionized matter of the LIC interacts with the expanding solar wind forming the heliospheric interface. The neutral component (interstellar atoms) penetrates through the heliospheric interface into the heliosphere, where it is measured directly as pick-up ions, atoms, ACR's, ENA's or indirectly through resonant scattering of solar Ly-α. When crossing the heliospheric interface, interstellar atoms interact with the plasma component .through charge exchange. This interaction leads to changes of both atom and plasma parameters. Using a kinetic model of the flow of the interstellar atoms, it is shown in the paper that the degree of filtration, the temperature and the velocity of the interstellar atom species depend on the interstellar proton number density. Comparing models computed for different interstellar proton densities with recent SWICS Ulysses pick up ion measurements, we constrain number densities of protons and H atoms in the Local Interstellar Cloud.

MAGNETOSHEATH CONDITIONS AND MAGNETOPAUSE STRUCTURE FOR HIGH MAGNETIC SHEAR

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The supersonic solar wind - Earth's magnetosphere coupling plays the main role in the solar wind energy, momentum and mass input into the magnetosphere. The variability of IMF and solar wind parameters leads to the global magnetosheath/magnetosphere reconfiguration. The new dynamic model of magnetic field in coupled solar wind - magnetosheath - magnetosphere system is considered. Magnetosphere is presented by the paraboloid model. The MHD equations in the magnetosheath, where the ohmic conducting solar wind plasma flow past the magnetosphere, are solved as a singularly perturbed system with two independent small parameters, which are inversely proportional to Mach-Alfven and magnetic Reynolds numbers.

The magnetic field near the magnetopause is formed due to mutual diffusion of the magnetospheric magnetic field in the solar wind and IMF into the magnetosphere. For the typical magnetosheath conditions, magnetopause thickness is about of 100 times less than stand-off distance. The proposed model allows to determine the reconnection efficiency, potential difference across the polar cap, energy input rate into the magnetosphere by IMF and solar wind parameters: velocity, density, conductivity. The calculated solar wind plasma and magnetic field parameters in the magnetosheath are compared with average variations of those obtained by AMPTE/IRM satellite for high magnetic shear.

DEVICE DETECTING NEUTRAL SOLAR WIND

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The Gas-2 device was designed to detect neutral atoms (especially H) of
the solar wind with typical energies of about 1 keV. To separate fast atoms
from intense flux of photons from the Sun the coincidence technique was
used. To estimate energy of detected fast atoms time-of-flight method was
used. The device was tested in two special designed vacuum facilities,
which gave opportunity to use neutral atoms and ions beams of various
kinds and energies in the presence of ultraviolet light. The two flight
samples were tested and calibrated and it was shown that Gas-2 could
really measure the various kinds of neutral atoms and ions in keV energies
region in the presence of UV light.

A HYDRODYNAMICAL FOUR-FLUID MODEL OF THE HELIOSPHERE

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Since the first heliospheric models one wants to know more about the
nature of the interaction between the solar wind and the interstellar
medium (ISM). Today we realize that not only the interaction of solar wind
protons and the ISM protons, but in addition of the interstellar neutrals, the

interstellar magnetic field and the galactic cosmic rays have to be taken into account. In the past years in particular the interaction between the solar protons and the neutral atoms was of interest. The charge exchange ionized neutral particles are picked up by the solar magnetic field and are accelerated to the solar wind velocity and belonging to the species of pickup ions (PUI). These ions can be energized by Alfv'en-waves and by the termination shock, where the supersonic solar wind is decelerated to a subsonic velocity, such that they are finally converted to anomalous cosmic rays (ACR), high energetic ions produced inside the heliosphere. In this talk we introduce a two-dimensional hydrodynamical description of this extended interaction scenario, including the consistent interaction of solar and interstellar protons, neutrals, PUIs and ACR's. The numerical results give a refined picture of the spatial distribution of these different plasma-species.

LONG-PERIODIC GEOMAGNETIC PULSATIONS OBSERVED BY GLOBAL NETWORK

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One-minute resolution digitized data on geomagnetic pulsations collected via INTERMAGNET satellites from global network of ground-based observatories are discussed. It is shown that for the magnetosphere of the Earth pulsations with the period of 8÷10 minutes are typical both for the night and for the day times. Despite the same frequency range the origin of these waves is different and depends on the latitude and local time.

RESEARCH OF THE POSSIBILITY TO USE INTERNATIONAL SPACE STATION INFRASTRUCTURE FOR GEOPHYSICAL AND ANTHROPOGENIC ELECTROMAGNETIC EXPLORATION

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The research program of the International Space Station (ISS) includes the geophysical researches and ensures the high scientific level of studies of the Earth ionosphere and magnetosphere. The unique scientific program includes the exploration of the ionospheric disturbances due to anthropogenic activities and due to the natural geophysical effects. The electromagnetic effects are of the great interest for the natural geophysical phenomena connected with e.g. earthquakes and volcanic eruptions. Wave emissions and electron density perturbations could be connected with the ionosphere by a variety of mechanisms. Only long-term statistical studies will reveal the general features of the ionospheric perturbations and help to find their specific signatures for the earthquake predictions. Most previous satellite experiments have operated at heights above 800 km. The unique feature of the proposed experiment is that regular observations for the first time will be performed at much lower heights, namely at about 350 km, at the ionosphere/ magnetosphere interface. The altitude of the ISS (about 400 km) is near the maximum of the ionospheric electron density (F_2-layer). Therefore this experiment has a good

opportunity to study the natural ionospheric perturbations in-situ. Global monitoring of electromagnetic radiation in the range from DC to tens of· MHz can be carried out only aboard satellites which allow to control the total Earth surface for a long time (more than 5 years) in the continuous automatic mode. It is very important that the obtained information will be immediately transmitted to the powerful computers, which are used in space researches and analyzed by wide community of scientists. The ISS, with life time 10-15 years, is the good candidate for the usage for the global electromagnetic monitoring.

POSSIBLE MANIFESTATIONS OF THE INTERACTION BETWEEN SOLAR WIND AND LOCAL INTERSTELLAR MEDIUM

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As the addition to the known evidences for the interaction between solar wind and local interstellar medium (LISM) obtained on aboard the spacecraft some results are presented confirmed this interaction using the baseground observations of the dynamics of solar magnetic fields of different scales. The solar magnetic fields are known to be drawn out from the Sun by the radially expanding solar wind and owing to solar rotation these fields take form of an Archimedes spiral in space. These rotating magnetic field structures interacting with the run over LISM gas at the heliosphere boundary can reveal the dynamical effects of the acceleration and slowdown of the rotation relative to its average annual value that are then transferred to the magnetic fields observed on the Sun. Analyzing the rotation velocity of the mean solar magnetic field and the magnetic field of active regions the seasonal non-uniformity was revealed that could be considered as a manifestation of this interaction.

NUMERICAL MODELING OF CME SHOCKS AND THEIR IDENTIFICATION IN LASCO DATA

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We have developed a numerical model of formation of shock waves by expanding magnetic structures, such as loops and arches. These shock waves have been detected in the solar wind at large distances from the Sun. However, their observation at short distance in the solar corona has been difficult. We have attempted to identify the shocks in the LASCO data by comparing the radial intensity profiles in limb CME with our theoretical model. We demonstrate that the shocks can be identified at least in some cases of CME of the simple loop-like structure. The LASCO observations give evidence for turbulent flows associated with the shocks. We have determined the speed of the shocks and expanding loops and compared with our model.

HEAVY IONS IN THE MAGNETOSPHERE OF MARS: PHOBOS 2/TAUS OBSERVATIONS

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One of the most exciting results obtained with the Phobos-2 Martian orbiter was the revealing of the plasmasheet inside the Martian magnetotail with

large fluxes of planetary heavy ions (mass/charge ratio M/q > 3). These fluxes were · recorded by the TAUS instrument in every · magnetotail traversal except one and the ion energy varies through the entire instrument range (0.03 – 6 keV). All the data on heavy ion fluxes obtained by TAUS are reviewed. 2-D heavy ion spectra are presented and discussed. Statistical analysis of plasma and magnetic field (measured by Magma magnetometer) data resulted in some dependences important for the consideration of possible ion acceleration processes.

ION FLUX GAPS IN THE INNER MAGNETOSPHERE OBSERVED BY INTERBALL-AURORAL

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Ion flux dropouts observed by mass spectrometers of the ION experiment of the INTERBALL-Auroral spacecraft. Such dropouts refered as "ions gaps" are registered in a wide MLT band in a morning, midday and evening magnetosphere at the invariant latitudes 62÷70°. These gaps are of two types: A) - monoenergetic gaps of 10÷14 keV seen in the evening and morning sectors, B) - gaps of 0.1÷8 keV with a reverse energy-latitude dispersion seen in all three MLT sectors. The comparison of experimental results and numerical calculations of the ion drift trajectories in the magnetosphere shows that gaps of an A-type observed at the low latitudes in the evening and morning MLT sectors could be explained by the fact that ion trajectories are closed and are not connected with a plasma source in the magnetotail. These gaps observed at the high latitudes in the morning MLT sector could be explained by the fact that ion trajectories leaves the magnetosphere on the evening side, so, ions do not reach the specified regions of the diffuse auroral zone in the morning sector. B-type gaps might be the result of the residence time of the drifting ions in the certain range of energies from the plasmasheet to the inner magnetosphere is higher than the lifetime of these ions.

OBSERVATIONS OF NEAR PLASMA SHEET, RING CURRENT AND
ENERGETIC ELECTRON RADIATION· BELT UNDER NORTHWARD ·
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The dynamics of different plasma domains is studied during the period
from 13 to 24 of March 1992 using data from GORIZONT 34 and
GORIZONT 35 geostationary satellites. Measurements of ion and electron
fluxes with the energy 0,1-12,4 keV, proton fluxes in the energy range 41-
133 keV and energetic electron fluxes with the energy 0,1-1 MeV have
been made. In that period it was recorded, on the one ·hand, SC
(17.03.92), the high-speed stream of the solar wind (600 km), crossing the
magnetopause by geostationary satellites (17.03.92), on the other hand,
any considerable geomagnetic disturbance was not observed. The basic
feature of the period was the northward orientation of the IMF from 17 to
21 of March 1992.
Beginning from 15.03.92, the significant softening of electron spectra in the
whole range of studying and decreasing their fluxes were observed,
especially in the quietest period of time (17÷20.03). The ion component
spectra in the energy range 0,1÷12,4 keV were harder with decreasing the
ion fluxes with the energy <1 keV. The ion fluxes of the ring current did not
essentially change.
The results consist qualitatively with the conception of a closed topology of
the magnetosphere for the steady northward IMF condition, when the
abrupt decreasing of the convective electric field ("dawn-dusk") happened,
and, in the same time, point to the dependence of the magnetospheric
mechanism of charged particle acceleration not only on· the solar wind
speed but on the IMF parameters.

SATELLITE RADIOSOUNDING AND RADIOTOMOGRAPHY OF THE IONOSPHERE

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K.I. Gringauz has always been interested in investigations of ionospheric structure using the radiosonding method. In 1965-68 K.I. Gringauz and his co-workers published a series of works (Gringauz, Kravtsov et al., 1965, 1966; Getmantsev, Gringauz et al., 1968) in which both local (in the immediate vicinity of the satellite) and integral (along the ray from the satellite to the receiver) effects were analyzed and it was shown that the contribution of local effects was small as compared to that of integral ones. The ideas put forward by K.I. Gringauz thirty years ago have been confirmed by the subsequent development of the method of radiosounding and radiotomography (RT) of the ionosphere, the latter being now one of the most efficient tools for investigating irregular structures of the ionosphere. The developed RT methods (Kunitsyn, Tereshchenko, 1991, Kunitsyn, Tereshchenko et al., 1995) allowed practical realization of several RT variants: for the first time structures of isolated ionospheric irregularities were reconstructed in 1984, sections of electron density spectrum fluctuations were recovered in 1987, global two-dimensional sections of the ionosphere were obtained in 1990. At present the diffractional RT allows investigations of localized irregularities with dimensions ranging from hundreds of meters to tens of kilometers with resolution about a hundred meters. The statistical RT makes it possible to obtain information on the electron density fluctuation spectrum. The ray RT method is used in many countries in various studies of large-scale structures with dimensions of hundreds and thousands kilometers with resolution of tens of kilometers at altitudes ranging from $100 \div 150$ to 1000 km. It should be noted that within the RT method it is possible to distinguish the contributions made by local and integral effects.

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APPEARANCE OF COMETOPAUSE-LIKE OUTER BOUNDARY OF
PLANETARY PLASMA DOMINATED REGION NEAR VENUS AND MARS

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While spacecraft Vega 1 and 2 were flying by the Halley comet a new
boundary where the primarily solar wind flowing toward the coma becomes
cometary ion dominated plasma had been detected. The IMF was found to
build-up inside the cometary plasma so that the cometopause features are
in contrast with elementary theoretical expectations: the resulting IMF
strength has to decrease toward the cometary coma because diffusion of
the IMF inside the cometary plasma has to be followed by the ohmic
dissipation. It was noticed the build-up of the IMF, which was observed
deep inside the Venusian ionosphere while the SW dynamic pressure
exceeded peak value of the thermal pressure of ionospheric plasma,
resembles with the IMF enhancement inside the cometary plasma. Near
Mars the peak IMF strength was measured inside the planetary plasma
too. Thus an outer boundary of planetary plasma region at both planets,
which have rather dense neutral atmosphere exposed to the SW flow, can
reveal cometopause - like features. It was even hypothesised that both
Venus and Mars are immediate analogue of a comet with low rate of
outgasing. Specifying conditions conducing the cometopause-like
boundary near Venus and Mars the processes resulting in the SW flow
termination: pick- up of heavy ions which are born inside magnetosheath
or had diffused outward from ionosphere, formation of 'bi-ion' boundary
and etc. are analyzed.

MAGNETOPAUSE POSITION DEPENDENCE ON THE B_z COMPONENT
OF THE INTERPLANETARY MAGNETIC FIELD. ANALYSIS OF THE
PRESSURE BALANCE EQUATION.

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Analysis of the available data set, containing numerous intersections of the ·
magnetopause by different satellites over more than 30 years leads to the
conclusion, that the form of the magnetopause should be approximated by
more complicated surface than those of the 2 order (ellipsoid, paraboloid).
The form of this surface is not only a function of pressure but also of the B_z
IMF component We used data on the change of the magnetopause form
induced by variations of interplanetary medium parameters, to analyze the
local contribution of external sources to the geomagnetic field at the
magnetopause as well as the variation of this contribution with changes in
the magnetopause point location.

MAGNETOPAUSE SHAPE FOR A DISTURBED SOLAR WIND AND IMF

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Observations at geosynchronous orbit are suitable to study magnetopause
under strong disturbed solar wind and IMF. Geosynchronous
magnetopause crossings (GMCs) identified by magnetospheric plasma
analyzer (MPA) from three spacecraft are studied. GMCs relied on .
magnetometer observations from ATS-1, GOES 2,5,6 satellites are used in
the study also. The GMCs and magnetopause crossing statistics are used
to construct magnetopause shape at geosynchronous orbit at the dayside.
Unusual magnetopause shape can explain whole set of experimental data,
which are not understood within the scope of common models. It is shown
the derived magnetopause shape is natural extension of the
magnetopause shape under weak disturbed solar wind and IMF.

SPECTRUM OF ELECTRON DENSITY FLUCTUATIONS RELATED WITH THE NEUTRAL GAS TURBULENCE IN PARTIALLY IONIZED PLASMA

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In the present report low-temperature, partially ionized plasma is considered taking the presence of uniform magnetic field and a gradient of background charged particle density into account. It is known that fluctuations of velocity field of neutrals in partially ionized plasma can induce fluctuations in ionization density, even though the motion of neutrals is incompressible. Assuming quasi-neutrality and isothermality, treating the motion of neutrals as given, an equation relating the electron (plasma) density fluctuations with the velocity field of neutrals is derived from the system of three-fluid equations. This equation describes a random process of generation of the density fluctuations, when the velocity field of neutrals is a turbulent one. Restricting the consideration of turbulence to the inertial sub-range of length-scales, where the Kolmogorov-Obukhov spectral law is valid for the random velocity field, an expression for the spectral density of the plasma fluctuations is obtained. The expression predicts both a power-law shape of the fluctuation spectrum and some possible changes in the spectral slope. The departures from a simple power law with a constant power index are explained by alteration in relative importance of the interaction of the velocity field with a gradient of background ionization and with magnetic field for the creation of plasma density fluctuations of different scales in particular. The comparison of obtained results with available data of ionospheric observations at middle latitudes shows quite a good agreement.

QUIET-TIME ELECTRON PLASMA AT GEOSYNCHRONOUS ORBIT

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$0.1 \div 13$ keV electron plasma measured onboard the geosynchronous satellite GORIZONT-35 is under consideration. We analyze the data within two intervals of low geomagnetic activity: 13-15 March 1992 and 18-20 March 1992. Plasma's behavior in these intervals is very unlike its typical behavior: night-side increases of intensity, related to the passing of a satellite through the plasmasheet, are significantly suppressed. Possible causes of this situation, such as the B_z orientation, are discussed. For these cases it is also estimated, the strength of the electric field responsible for the electron plasma convection.

KONSTANTIN GRINGAUZ'S CONTRIBUTION TO THE DISCOVERY OF THE PLASMAPAUSE, AND LATEST NUMERICAL SIMULATIONS OF THE PLASMASPHERE DYNAMICS

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The history of the discovery of the plasmapause by K.I. Gringauz will be reported. The subsequent observations, which confirmed the existence of a sharp "knee" in the high altitude distribution of the cold ion and electron densities, will be briefly recalled. The origin of the outer boundary of the plasmasphere will be discussed. Numerical simulations of the time dependent positions of this highly dynamical surface will be reviewed.

RADIO MAPS OF THE SOLAR WIND TRANSITION REGION ON EPOCH OF SOLAR MINIMUM

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Occultation studies of near-Sun plasmas using several natural sources
simultaneously result in large-scale patterns, radio maps of the solar wind
flow. Large radio telescopes of the P.N. Lebedev Physical Institute,
Pushino, were used. The 1995-1997 experiments showed that the
evolution of the transition region geometry is very close to that of the
optical corona. This experimental fact is discussed in connection with the
large-scale magnetic field on the solar surface.

BEAMS OF ALMOST MONOENERGETIC IONS NEAR THE EARTH'S MAGNETOSPHERE BOUNDARIES

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More then 200 cases of energetic ion beams with energy spectrum
consisting of 1-3 narrow lines were observed during a period from August
1995 to September 1997 in the Earth's magnetosheath and in the region
upstream of the Earth's bow shock. It was done in a course of DOK-2
experiment onboard of INTERBALL-1 spacecraft. The relative width at half
maximum of these lines varied from 5 to 30%, that is why we use the term
'Almost Monoenergetic Ions' (AMI) for these events. The fact that AMI
events were not observed in numerous previous experiments can be
explained by short duration of the events (≤ 1 min) and insufficient energy
resolution of spectrometers used before. Ion energy values varied for
different events from 30 to 600 keV but are almost unchanged during each
event. In ~50% of cases there were 2 peaks in spectra with their energies

ratio of 1:2. In ~7% of cases the spectra have 3 peaks with their energies relating as 1:2:5-6. AMI events were observed when the spacecraft had magnetic field connection with the bow shock or magnetopause and the energetic particle telescope was directed to the side of the connection point. Such line spectra can not be explained by models of particle acceleration or escape from the magnetosphere accepted now. We deal here possibly with some new process in near Earth's plasma or some unexpected manifestation of previously known processes. We propose a hypothesis explaining main features of AMI. It is based on the assumption of an electrostatic field burst in small region on the magnetopause.

INTERCHANGE INSTABILITY OF DRIFTING MAGNETOSPHERIC PLASMA

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As shown by Volkov and Maltsev [Geomagn. Aeron., 1986, V.26, 798], the bulk magnetospheric convection leads to the interchange instability not only at the outer boundary of the plasma sheet but almost everywhere in the magnetosphere. We have examined influence of the thermal spread of magnetospheric protons on the growth rate of the instability. The spread appears to broaden the area of unstable modes.

VARIABILITY OF THE ELECTRIC CURRENTS IN THE MAGNETOSPHERE

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We used several thousand magnetic measurements in the distant magnetosphere to study differential responses of the magnetospheric currents to various geophysical parameters. It is shown that the growth of the solar wind dynamic pressure intensifies the magnetopause and magnetotail currents. The IMF vertical component affects the Region 1

field-aligned currents. The substorm activity gives rise to growth of the cross-tail current. The storm development is accompanied by the increase of both the ring and cross-tail current, the latter effect being dominant.

OSCILLATORY DISINTEGRATION OF NONEVOLUTIONARY SHOCK WAVES

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We suggest a new scenario of nonlinear evolution of nonevolutionary shocks. For such a shock the problem of time evolution of its small perturbations does not have a unique solution. Therefore, it cannot exist as a stationary configuration and must disintegrate or transform some other nonsteady flow. Evolutionary are fast and slow shocks, while trans-Alfvenic shock waves (TASWs) are not. This conclusion remains valid when the effect of shock structure is allowed for. At the same time, an Alfven discontinuity (AD) becomes nonevolutionary in the presence of arbitrarily small but nonzero dissipation. We show that the contradiction inherent in the nonevolutionary shock is removed if its evolution has the form of oscillatory disintegration, i.e., reversible transformation to the AD. As a result, the discontinuity is in some intermediate state between these two during most of the time of its evolution. In this state the flow cannot be identified as one of the known types of discontinuities. Such an approach allows us to reconcile the theoretical results with the experimental data according to which TASWs are observed in the solar wind much more rarely than evolutionary shocks.

SIMILARITIES AND DIFFERENCES CHARACTERISING THE SOLAR
WIND INTERACTION WITH COMETS OF LOW (P/GRIGG-
SKJELLERUP) AND OF HIGH (P/HALLEY) Q VALUE IDENTIFIED IN
THE DATA OF THE ENERGETIC PARTICLES INSTRUMENT EPONA
ON SPACECRAFT GIOTTO (E ~60 ÷ ≥260 KEV)

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One of the key drivers underlying the decision to command the Giotto
spacecraft on to an encounter with comet P/Grigg-Skjellerup (G-S)
following its highly successful encounter with P/Halley, was the opportunity
this provided to compare measurements made with the same suite of
plasma and fields instruments of a comet having a low gas production rate
(G-S) with very active and "fresh" comet Halley. In the present paper,
similarities and differences between the signatures of characteristic
boundaries recorded in energetic particles (range E ~60 ÷ ≥260 keV) at the
above mentioned comets by the EPONA Energetic Particle Detector
instrument on Giotto are discussed in the light (a) of the specific
interplanetary circumstances characterising each encounter.

WAVES GENERATED IN THE VICINITY OF THE XENON PLASMA GUN
IN THE APEX-EXPERIMENT

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Wave and plasma observations were made in the close vicinity of a plasma gun on altitudes near 500 km in the APEX-experiment. Hundred second pulses of xenon injections with 2A current and energy 250 eV were realized in two regimes: without modulation and with modulation by frequencies 62, 125, 250, 500 or 1000 Hz. Wideband noise, associated with the neutral gas releases and steady currents beam have been detected. In modulation regime even and odd harmonics of the beam modulation were observed. The delay of signal after the modulation beam injection has been detected. The last effect was associated with the electron density disturbance, measured by plasma density device. Regions, where this effect was frequently observed, were situated at night side of the Earth on high latitudes beyond plasmapause. They are characterized by electron temperature anisotropy, related with the soft electron flows. Dynamic spectra of exciting noises are similar to electrostatic noises, although magnetic component, related with transformation of waves on plasma inhomogeneties, have been observed too. In these regions longitudinal currents are observed, which are detected by magnetometer. According its data there is possible separate effects of noise excitation in current's regions and outside them. In first case we have significantly higher intensity of the noises.

FRACTIONAL HOP WHISTLERS PROPERTIES OVER SEISMOACTIVE REGIONS

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Results of amplitude spectra investigations of whistler on wide band from 70 to 15000 Hz, registered on Intercosmos 24 satellite during its passes above European earthquake regions at different geophysical conditions are presented. Using the large volume of data and analyzing the intensity and form of the fractional hop whistlers amplitude spectra, observed in day time at different geophysical conditions, there are showed the next peculiarities:
1) in quiet period, when seismic and geomagnetic activity is lacking, spectra involve advantageously ELF components ($f < 3$ kHz) with higher cut off frequency $f_c \sim 1.5$ kHz. This result agrees with theoretical

introducing about properties of ELF and VLF wave penetration from waveguide Earth-ionosphere to outer ionosphere;

2) with geomagnetic activity increase the higher cut off frequency of ELF spectrum is shifted to lower frequencies (700-1000 Hz) that is consequence, according to theory, of attenuation ELF wave increase at their penetration through D region of the ionosphere;

3) in seismoactive period in preparing phase of earthquakes the high cutoff of whistlers is shifted to higher frequencies (2.5 - 3 kHz). It is observed appearance of VLF components, that means better penetration of ELF, VLF waves through D region.

REGIONS AND BOUNDARIES OF COMETARY PLASMA ENVIRONMENTS

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We examine and intercompare the plasma regions and boundaries between bow shock and cometopause at three comets: Giacobini-Zinner, Halley and Grigg-Skjellerup. The question is discussed: are boundaries the stable structure or they appeared by time non-stationary phenomena? The main properties of these boundaries are: change of ion content, gradient of high energy electron density, rotational discontinuity of magnetic field **B**, depression of **B** module, appearance and jump of ULF wave intensity. Doubtless, the boundary positions are related with mass flow, sublimated from comet surfaces. However for comet Halley time variations of rotational discontinuity coincide with time variations of Solar wind (SW). It is argument in favor, that boundary properties are resulted of interaction with SW and related with its properties.

VLF EFFECTS IN OUTER IONOSPHERE FROM THE UNDERGROUND
NUCLEAR EXPLOSION ON NOVAYA ZEMLYA ISLAND 24 OCTOBER
1990 (SATELLITE INTERCOSMOS 24 DATA)

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The results of digital processing of auroral hiss and whistler data,
registered on INTERCOSMOS 24 satellite on ~1000 km height at the pass
over Novaya Zemlya island 17 minutes past the moment of the
underground nuclear explosion have been presented. As a result of power
acoustic influence on the ionosphere and the magnetosphere, abrupt
increasing (~20dB) of the VLF hiss intensity has been detected in narrow
band of invariant latitudes ($\Delta\Phi \sim 3.9$), including the disturbance source.
Spectral power density was modulated with space intervals near 100 and
23 km. Simultaneously in the plasmasphere in a wide latitude interval from
50 up to 30 degrees several groups of whistlers with unusually number of
echoes (>37) has been registered. One hop whistler of these groups had
the same dispersion, and the time interval between the echoes was
constant and equal to 2.9 ± 0.2 s.

MULTISCALE STRUCTURE OF THE INTERPLANETARY MAGNETIC
FIELD: FRACTON EXCITATIONS AND THE POWER-LAW SPECTRA

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We study the statistics of the magnetosonic waves on the clusters of the
IMF whose geometry is approximated by a fractal. Our prime interest
concentrates on the role of these waves in formation of the power spectra
of the IMF fluctuations in the corresponding frequency ranges. We argue
that the magnetosonic waves on the fractal clusters of the IMF could be
considered as a specific type of quasiacoustic excitations termed fractons
having an "unconventional" dispersion law depending on the topological
properties of the fractal cluster. In this context, we propose an
unconventional type of wave equation with the *fractional* time derivative,

which generalizes the standard wave equation for the fractal geometries. We found an analytical solution to the generalized wave equation on fractals, enabling one to calculate directly the power spectra of the IMF turbulence. Our results show a good agreement with the direct spacecraft measurements of the IMF turbulence in a wide range of frequences and heliocentric distances.

A TYPICAL SUBSTORM AS TAIL STRETCHING INSTABILITY

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The near-Earth open tail reconnection was considered for a long time as the principal process creating magnetospheric substorms and storms. Later, the small-scale innermost cross- tail disruptions (CD's) have been suggested as an alternative. At the present time, these two paradigms co-exist, and it is know their synthesis. However, the traditional database for substorm studies does not contain some direct indicators of the open tail reconnection. Therefore, the major uncertainties in the present time state of the theory are preserved.

We used the traditional database for study of number substorms, supplemented by data of magnetogram inversion technique MIT2, which allowed us to calculate plots of the open tail magnetic flux Ψ. The results obtained clearly show that a typical substorm is the regular sequence of both above-mentioned processes. At first (but after the growth phase), the clear signatures of the innermost cross-tail current disruptions (CD's) are observed, during grow of Ψ and the tail stretching, without the open tail reconnection. It lasts ~10÷60 min that is the first active phase of a typical substorm. After the tail length attains the second (higher) threshold (~200÷300 R_e), the 2nd active phase begins in the mid- tail. It means a sudden contraction of the tail (till 30÷50 R_e) by the near- Earth open tail reconnection, and the substorm ends (after the recovery phase) or a new cycle begin.

In this scenario, CD's - and NENL- processes evolve in different space-time regions, being controlled not only by boundary conditions but also by the global intramagnetospheric tail stretching instability, where energy input into the magnetosphere increases the energy input rate.

STRUCTURE OF THE RING-CURRENT OUTER REGION DURING SOLAR MINIMUM

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. The spatial and temporal distribution of charged particles in the region the ring current during a period of the solar activity minimum (from September 1995 to September 1996) is analyzed. The study is based on measurements made by the energetic particle spectrometer SKA-2 and plasma spectrometer PROMICS-3 onboard the satellite INTERBALL Tail Probe. The emphasis is on the study of the ring-current outer edge in the night-side magnetosphere. A strong ring-current outer edge nonstationarity was found over a wide longitude range.

VARIATION OF THE HELIOSPHERIC MAGNETIC FIELD STRENGTH FROM 3 TO 66 AU: VOYAGER 1: 1978 THROUGH 1996

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We discuss Voyager 1 (V1) observations of the heliospheric magnetic field strength from 1978 through 1996. During this period the distance of V1 from the Sun increased from 3 AU to 66 AU and its heliographic latitude increased from 50°S to 30°N. The magnetic field strength profile is consistent with Parker's spiral field model when one considers: 1) the solar cycle variation of the observed magnetic field strength at 1 AU, $B_1(t)$ (which is a measure of the source field strength) and 2) the latitudinal and solar cycle variations of the solar wind speed, $V(t,0)$. Both $B_1(t)$ and $V(t,0)$ make significant contributions to the magnetic field strength variations observed by V1. There is no evidence for any magnetic flux deficit, as reported by

Pioneer 10 and 11 investigators, and which increases with distance from the Sun.

RECENT STUDIES USING THE ACE AND WIND MAGNETIC FIELD EXPERIMENTS

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Both the WIND S/C and Advanced Composition Explorer (ACE) are now on station at the sunward Lagrange point, L_1, monitoring the interplanetary medium with a complex suite of instruments for in-situ magentic field, plasma and energetic particle studies. The combined ACE and WIND observations provide a unique opportunity to study a wide variety of interplanetary disturbances (shocks, magnetic clouds, magnetic holes, etc.) and to obtain new insights into the nature of the fluctuations of the interplanetary field. We will discuss some recent results from initial studies of interplanetary disturbances and include an overview of recent efforts to better understand the dissipation range of magnetic fluctuations.

AN ALTERNATIVE VELOCITY MODEL FOR THE SOLAR WIND

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We keep arguing an alternative concept of the solar wind (SW) suggested previously by Nikolskaya & Valchuk (1997,1998), using solar wind velocity measurements in the inner heliosphere available. This concept treats the solar wind and the solar corona as a products of the primary high speed plasma outflow injected into the coronal base. Solar corona is formed and heated by the capture of these primary outflows by the closed coronal magnetic fields whereas the fast solar wind is the same primary streams

leaving the Sun through the open magnetic fields of the coronal holes. The velocity profile V(r) for the inner solar wind is presented calculated in terms of the alternative concept using the SW speed data for the outer heliosphere (Ulysses). Contrary to recent SW acceleration models our model exhibits very fast solar wind (up to 970 km/s) near the solar surface with steep decrease velocity down to 780 km/s between heliocentric distances $1R_s$ and $7R_s$ and following slow velocity decrease till V = 750 km/s at 1AU. Such a velocity profile agrees very well with SW speed measurements in the inner heliosphere down to $10R_s$ that can be considered as convincing argument in favour of the alternative SW concept.

K.I.Nikolskaya, T.E.Valchuk, Cosm.Res. **35**, No.2, 133, 1997 (in Russian).
K.I.Nikolskaya, T.E.Valchuk, Geomagn. & Aeronom, **38**, No.2, 14, 1998 (in Russian).

THE POSITION OF THE MAGNETOTAIL CURRENT SHEET: A COMPARISON OF EMPIRICAL MODELING RESULTS WITH THE INTERBALL -1 DATA.

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Data from magnetometer measurements onboard Interball-1 satellite are processed in order to study the current sheet motions. We use data with 2 minute resolution obtained during October 1996 when the satellite was situated in the middle tail region. Current sheet crossing are found. Model current sheet positions for the same time intervals are evaluated using empirical formulae by Gosling (1986), Fairfield (1987), and Tsyganenko (1995). The Geopack package is used to calculate the respective tilt angles. Comparison of the experimental and the model position for selected time intervals is made. The dependence of deviation of the current sheet on the geomagnetic activity is studied.

ELECTRODYNAMICS OF THE POLAR SOLAR WIND

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Theoretical (MHD) study of the thermally expanding polar corona above the rotating magnet has been considered. Possible existence of the double electric layer, field-aligned currents and initiated by them additional pressure gradient, leading to the additional to Parker's acceleration of the polar solar wind, are discussed.

ADIABATIC INDICES IN AN ANISOTROPIC PLASMA WITH THE PROTON PITCH-ANGLE DIFFUSION BEING TAKEN INTO ACCOUNT

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The effective polytropic index γ_{eff} in magnetized anisotropic plasma is considered. The value of γ_{eff} is found to depend on the characteristics of the plasma flow (magnetic compression index) and on the plasma temperature anisotropy.
.Experimental profiles of .the perpendicular and parallel proton temperatures across the magnetosheath are studied, and it is shown that the observed values of the temperature anisotropy may be explained by a rather intensive pitch-angle diffusion of the magnetosheath protons. The relaxation time of the proton temperature anisotropy obtained from the parallel temperature profiles is shown to be systematically greater than that obtained from the perpendicular temperature profiles, which suggests existence of some sinks of the perpendicular proton energy.

MHD-MODEL OF THE MAGNETOSHEATH IN THE CGL-APPROXIMATION

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Parameters of the magnetosheath plasma and magnetic field are calculated in the frame of a quasi-two-dimensional model in the anisotropic plasma approximation. It is shown that the error associated with the neglect of the plasma temperature anisotropy of the order 1.5-3 (a typical value of the anisotropy for the magnetosheath plasma) is relatively small, which makes it possible to use existing now isotropic models for estimates of the plasma density and magnetic field intensity within the magnetosheath.
What concerns the proton temperature, the usual double-adiabatic models predict highly overestimated values of the temperature anisotropy, which suggests existence of relatively intensive proton pitch-angle diffusion in the magnetosheath plasma.

HOT PLASMA PRESSURE VARIATIONS ON THE GEOSTATIONARY ORBIT ON THE BASE OF GORIZONT SATELLITE DATA

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Data of ADIPE-35 spectrometer installed on the geostationary satellite GORIZONT 92/2 was used for the determination of hot plasma pressure distribution. Spectrometer measured ion flux with energies from 0.1 till 133 keV. It was suggested that quite time particle fluxes are near to isotropic. The accuracy of such determination is discussed. Plasma pressure dependencies from local time, solar wind parameters and geomagnetic activity are analyzed for the period from 11 till 25 March 1992. The main feature of analyzed database was the existence of prolonged period of northward IMF orientation and SC magnetopause compression. It is shown that plasma pressure constitute of the order of 1 nPa and has pronounced

azimuthal dependence. The results of plasma pressure calculations are compared with plasma pressure meanings obtained on geostationary and high apogee orbits. It is shown that determined meanings of hot plasma pressure are in good agreement with the results obtained in other experiments. Possible contribution of near geostationary plasma population to the formation of magnetospheric current systems is discussed.

PROGRESS IN LOW-ENERGY ELECTRON MEASUREMENT TECHNIQUOS

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Low energy electron measurements in space are difficult to perform mainly because the spacecraft potential and space charge around the spacecraft affect the results. The measured plasma electron spectra are normally polluted by photoelectrons.
The precautions which have to be taken to minimize these detrimental effects are described and the designs of a few respective instruments shown. What can be learned from accurately measured electron spectra is exemplified by means of Helios results.

PROPERTIES OF CORONAL ALFVEN WAVES FROM TWO-STATION FARADAY ROTATION OBSERVATIONS

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Faraday rotation fluctuations (FRF) of polarized radio signals, observed during solar conjunction of the Helios spacecraft, are used to investigate

Alfven waves in the solar corona. Surprisingly, in some cases the time lags derived from a cross-correlation analysis of FRF measurements recorded simultaneously at two widely-separated ground stations can be both positive and negative, implying that the Alfven waves propagate both away from and toward the Sun. The cross-correlation functions vary slowly with time, usually featuring a single maximum. The occasional presence of two equally strong maxima is thought to be an indicator of wave propagation in opposite directions. Theoretical cross-correlation functions are computed for a power-law spatial spectrum of magnetic field fluctuations. A comparison of these models with the data shows that the changing form of the cross-correlation function can be attributed to variations in intensity of the inward- and outward-propagating waves. The results are used to estimate the Alfven speed and background magnetic field strength at coronal distances near 10 solar radii.

LONG-TERM VARIABILITY OF THE SOLAR WIND DYNAMIC PRESSURE AND ITS CLIMATE CONSEQUENCES

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We studied long - term variability of the solar wind dynamic pressure for the satellite epoch - (1960-1993). There was a notable increase of this parameter since about 1972 and it still continues now while the solar spot number varies in its usual cyclic way. Comparing the rocket sounding data of the polar middle atmosphere temperature with the synchronous solar wind dynamic pressure values we found that the former parameter depends on the latter one, especially in winter and under the Eastern QBO orientation. We also found that the experimentally measured parameters of the ozone layer in the polar stratosphere depend on a position of the Earth magnetosphere magnetopause, which is shifted toward the Earth with the solar wind dynamic pressure increase. We conclude that the solar wind dynamic pressure can influence the climate of the high-latitude regions during winter.

NTERPLANETARY SHOCK WAVES FROM RADIO SCINTILLATION DATA

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The structure and evolution of the interplanetary shock waves are obtained by scintillation observation of the large number of radio-sources. The analysis of observational data gives some parameters of shock waves. Typical angle size of shock front is about 40÷60° on heliolatitude and heliolongitude. The dependence of scintillation index m on a shock front surface distance can be represented by a two-component structure. The first component occupies a narrow layer with thickness of about 0.02 AU and strong enhancement of turbulent level. The second component occupies a layer with thickness of about 0.1 AU and weaker enhancement of turbulent level. The velocity of the shock front V decreases with increasing of the distance from the Sun r. The deceleration rate of the shock front velocity depends on the initial value of shock velocity. For the case of high speed shock waves the observed dependence V on r stronger than the dependence which is given by the scaling and numerical solutions. The effect of turbulence on interplanetary shock waves propagation is considered.

RELATIONSHIP BETWEEN THE GENERATION OF LOW-FREQUENCY AURORAL KILOMETRIC RADIATION, HIGH FREQUENCY WIDE-BAND EMISSIONS AND CHARGED PARTICLE FLUXES AT AURORAL AND POLAR LATITUDES

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·The results of simultaneous observations of charged particle fluxes within the energy range 50 eV to 20 keV (PEAS experiment) and plasma wave parameters within the frequency range 0.1 to 10 MHz (PRS-3 experiment) on board the APEX spacecraft are presented. The data were obtained at polar and auroral latitudes in the dawn-dusk and noon-midnight time sectors. The low-frequency (LF) sporadic emission mainly on frequencies lower than the local gyrofrequency was commonly observed within a comparatively narrow latitude interval (~5°- 6°) of the auroral oval. The maximum of spectral wave intensity was revealed at a frequency of ~ 200 kHz. The sporadic character of the observed emissions, the spectra, are very similar to those reported for auroral kilometric radiation (AKR), and the temporal and spacial occurrences imply its relation to the source of AKR emissions measured at the higher altitudes, with regards to our wave measurements as LF AKR-type emissions. Comparative analysis of spatial distributions of charged particle energy spectra and variations of wave spectra at auroral oval latitides showed that several conditions should be fulfilled for LF AKR generation. These conditions are related both to the intensity and energy of precipitating ion and electron fluxes, and albedo electrons and the ionospheric plasma parameters. The wideband HF emission was observed together with the LF AKR-type emission during the morning auroral oval crossing. At spacecraft apogee altitudes, in the polar cap zone intense electron precipitations and an increase of plasma noise intensity at frequencies equal or below f_{He} were observed at the period the IMF was northward. These precipitations and emissions were accompanied by the horizontal currents crossing the polar cap, so-called theta structure.

PIONEER VENUS OBSERVER PROGRAM NEEDS FOLLOWED-UP
PIONEER VENUS EVALUATOR PROGRAM

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The Pioneer Venus Observer (PVO) orbited Venus for a long time and supplied valuable data. Analyses of these data provided some interesting information about Venus atmosphere and the phenomena occurring therein. Some of these results and their interpretations have been questioned, widely discussed in various scientific meetings and have been

published in leading scientific journals. These developments were scientifically rich which could be used as a valuable store· house for designing, developing and operating more sophisticated scientific probes to be launched aboard future PVO missions with a view to resolve some of the controversies and come out with more reliable information about various phenomena in the Venus atmosphere. The in-situ measurements of strength of electromagnetic waves at four different frequencies by one of the proves aboard PVO was interpreted by various workers. The evidence of lighting in Venus clouds was put forward by one group and refuted by the other group. Such controversies are natural and arise primarily due to inadequacies should be removed by devising much more sophisticated probes. The measurements of electromagnetic wave strength covering an extended frequency range over a considerably long period of time resolve the issues of Venus lighting and many more related features. The settlement of lighting Venus clouds is very important since it is an important indicator of existence or otherwise of some form of life. The paper concludes with strong arguments in favour of an improved future missions of PVO program sponsored by the global scientific community.

THE ROLE OF TRANSIENT ELECTRONS IN RE-EXAMINATION OF THE LINEAR STABILITY OF THE QUASI NEUTRAL SHEET TEARING MODE

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The linear stability of the tearing mode in the magnetotail current sheet with nonzero normal component of the equilibrium magnetic field first obtained by Lembege and Pellat (1982) considered the electrons to be trapped in the current sheet. The sufficient stability criterion severely limits tearing instability, interpreted as due to electron compressibility. The electron population in the current sheet however consists of trapped as well as transient populations. The integral equation for the perturbed electron density including both these populations is obtained within the drift kinetic approximation. It is shown that due to the transient population the electrostatic contribution to the flux tube integrated electron density does not vanish, but dominates at sufficiently small electron temperature (T_e). The new sufficient criterion of stability is obtained. As compared to the original criterion of Lembege and Pellat (1982) the stability condition is

reduced by a factor of $(3T_e/T_i)^2$ where T_i is ion temperature. Therefore marginal stability state may be reached for sufficiently cold electrons.

INTERBALL-TAIL OBSERVATIONS OF THE PLASMA STRUCTURES IN LLBL

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The Interball Tail observations show that the transient bursts in LLBL indicate the deceleration, heating, and dissipation of magnetosheath-like plasma while satellite moves inside the magnetosphere with decreasing geocentric distance. These bursts have distinct structure that does not change significantly with the evolution of plasma properties: the fast and dense front part, preceded by diffuse front envelope, less dense trailing part, separated from the front part by more diffuse plasma, and diffuse rear envelope. The plasma bursts are largely impenetrable for magnetospheric plasma. At least part of these plasma bursts has FTE signature. The change of polarity of B_n component approximately corresponds to the separation of the plasma burst in leading and trailing parts. Velocity profile within plasma burst suggests that the rear part may represent the wake of the plasma parcel penetrated from the magnetosheath to the magnetosphere. There is evidence that plasma penetration through magnetopause is associated with a non-stationary reconnection.

A STUDY OF THE IMF FLUCTUATION SPECTRUM IN THE SOLAR ACTIVITY CYCLE

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Temporal changes in behavior of the IMF fluctuation power spectra in the frequency range ~ $10^{-4} \div 2 \times 10^{-3}$ Hz are studied. The 5-min data of the IMF module, obtained aboard IMP-8 for 1980-1991, are used. For the analysis information on the low-energy cosmic ray flux (E_p > 1 MeV), frequency of geomagnetic storms with a sudden commencement (SSC) and sunspot numbers has also been attracted. It is shown that a level of small-scale ($10^{10} \div 10^{12}$ cm) turbulence of solar wind is naturally changed in the 11-year cycle of solar activity. It may be inferred that low-energy cosmic ray fluxes, associated with flare activity of the Sun, can generate MHD waves in the vicinity of the Earth. Evidence for the appropriate changes of the IMF spectrum index in the solar cycle has been obtained.

STUDY OF INTERRELATIONS BETWEEN SOLAR ENERGETIC PARTICLE EVENTS, SOLAR FLARES AND CORONAL MASS EJECTIONS.

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In the last few years the new paradigm of causal relations of active processes in solar atmosphere and interplanetary space is actively propagated. According to this paradigm traveling interplanetary shocks, large solar energetic-particle (SEP) events and large non-recurrent geomagnetic storms are produced by coronal mass ejections (CMEs), not by solar flares. In practice, it means a complete change in the understanding of particle sources, acceleration and propagation in SEP events. However such a change requires more detailed consideration and confirmation.

In the present report we will try to get real estimates of contribution of various nature sources to SEP events in inner heliosphere. We discuss results of analysis of interrelations between proton and electron components in SEP events, flare electromagnetic emissions, CMEs and interplanetary magnetic field. We consider SEP events observed onboard Helios 1,2, IMP 7,8, ISEE 3, Venera 11-14, Vega and Phobos s/c between 0.7-1.5 AU during the period 1979-1989. Statistics includes about 70 events related to flares associated with CMEs and nearly the same number of events after flares without CMEs. Dependences of SEP events' time-scales and amplitudes, spectra of 0.03-1.5 MeV electrons and 1-100 MeV protons, as well as e/p- and H/He-ratio, on CME speeds and angular

widths and interplanetary shock parameters are presented. 25 events were observed simultaneously at different points in the wide range of angular distances between observation point and source region near the Sun. So it became possible to divide time and spatial variables in the task of interrelations between SEP-events and flares and CMEs. Multispacecraft observations let us consider influence of CME-driven shocks on SEP fluxes at various azimuthal angles relative to shock nose and so distinguish effects of flare and shock acceleration.

ON THE DAYSIDE BOUNDARY LAYER BETWEEN THE SHOCKED SOLAR WIND AND THE IONOSPHERE AT MARS

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The objective of this paper is to explore what are the structure and the properties of the interaction layer between the shocked solar wind and planetary plasma at Mars. We call this interaction layer as the magnetic barrier region. This study is based on the observations obtained by the plasma instruments carried on board of the Phobos 2 spacecraft. The investigation leads us to conclude that at Mars there exists an interaction region with the following characteristics: a) the bulk of the shocked solar wind protons is deflected, b) the total magnetic field increases c) a plasma depletion region is formed, d) in the region both the shocked solar wind and planetary plasma are present, e) accelerated electrons and heavy ions are present, f) intensive wave activity is seen in the 5 to 150 Hz frequency interval, g) current layer and associated magnetic shears can be identified. We shall make an attempt to model the physical processes leading to wave excitations in this region, pointing out the similarity between the mechanism operational here and in the mantle of Venus.

INTERPRETATION OF ION ENERGY SPECTRA OBSERVED BY THE VEGA SPACECRAFT AT COMET HALLEY

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The Solar Direction Analyzer and the Cometary Ram Analyzer of the PLASMAG instrument detected the energy/charge spectra of ions (without mass separation) aboard the Vega spacecraft. Downstream of comet Halley's bow shock, the energy spectra showed the joint effect of decelerated solar wind particles and cometary pickup ions of different masses. Since PLASMAG could observe only two relatively small sections of velocity space, the separation of the different ion components was attempted by using some results provided by a 3D multiscale MHD model developed by Gombosi et al. (1996). Simple plasma distributions were determined for the different ion populations by applying measured, calculated, and free parameters. The observed spectra could be better interpreted when supposing that the cometary pickup ions had a bispherical shell distribution (applying magnetic field vectors measured by the MISCHA experiment) instead of using the spherical distribution.

THE EARTH BOW SHOCK OBSERVATIONS WITH RADAR SURA-WIND

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Some results of the solar wind observations by coordinated operation of the Russian SURA radar facility and the remote NASA WIND spacecraft are presented. The SURA facility successfully is being used in experiments with ionospheric modification by powerful radio waves, radar investigations of near outer space, and radio astronomy observations. 144 crossed dipoles array (operating frequency range 4.6-9.3 MHz) and three HF transmitters with effective power radiation of 150 MW compose its basis. The WIND experiments (apogee 80-230, perigee 10-15 Earth's radii) is a part of the Global Geospace Science initiative intended to study the flow of energy and matter in Earth's magnetosphere. Among the spacecraft equipment is the WAVES instrument which primary goal is to observe radio and plasma wave phenomena of space origin. The RAD2 WAVES receiver designed to measure electric fields from 1.075 MHz to 13.825 MHz covers the SURA frequency range. The SURA-WIND collaboration stems from August 1995, when the SURA signals at 9 MHz have been successfully registered by RAD2 with signal to noise ratio more than 30 db for the WIND-Earth departure of 0.5 million km. The 1995-97 campaign has clearly demonstrated the flexibility of this 'new' instrument: bi-static decametric radar, using Earth-based radar and a space-borne receiver for investigation of near-Earth space plasma environment by radio sounding technique.

In particularly it has been shown that when WIND is located out the Earth's magnetosphere the radar would permits to recognize 40-400 km inhomogeneties, which are near of the upper boundary of inertial interval of the solar wind turbulence. At the report the results of more than 30 radar sounding sessions (summer 1997) at 9 MHz frequency range are presented. The sessions were performed during of the coming minimum of solar activity, when the ionosphere cutoff frequencies are as low as 4-5 MHz during daytime. Almost for every sample of scintillation spectra calculated for the SURA signals it is observed a high frequency singularity in the 0.4-6 Hz range, which could be referred to radio waves scattering by the solar wind clouds. The peculiarity immediately appears when the spacecraft leaves on the magnetosphere. It has not been recognized any correlation of the values: scintillation index and typical scintillation frequency versus the WIND-Earth departure of the 15-230 Earth radii range. An analysis of the results, with taking into account the observations of the solar wind by WIND instruments in situ, has been implemented. It is resumed that the main contribution into interplanetary scintillations observed along the SURA-WIND path was supplied by the region of enhanced solar wind turbulence in the site of near Earth bow shock.

CALIBRATION OF WAVES RECEIVERS OF NASA WIND SPACECRAFT BY NATURAL AND MAN-MADE ORIGIN EMISSIONS

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A lot of scientific satellites are using HF.antennas as the sensors of radio waves to study radiation processes in inter planetary medium. Some sophisticated techniques are developed to determine a spatial and temporal parameters of the radiation which are important descriptive features of space plasma sources. During the period of 1995-97 several teams from US, France, The Netherlands, Russia, and Ukraine have been joint for near space objects investigations by decameter radio sounding technique which combined the NASA WIND spacecraft and SURA radar facility. The radar (operating frequency range of 4.6-9.3 MHz) was carefully calibrated by various techniques at a its previous exploiting. The signal to noise ratio for the WIND RAD2 receiver at 9 MHz has exceeded 20 dB at every point of the spacecraft orbit. We used the opportunity for to calibrate the antenna system of the spacecraft at the frequency 9 MHz. The ratio of RAD2 outputs voltage for ON-OFF transmitter periods has been examinated. The well-known radar equation was used to estimate the flux power density at the spacecraft site. The effective power radiation of the radar as well as the WIND-Earth separation distance and evaluated value of gain of short spacecraft's antenna (15 m length) have been taken in view. It was suggested that during the transmitter silence the observed antenna temperature is equal the temperature of cosmic background (400 000 k at 9 MHz). As. an average result for more than 40 SURA-WIND sessions carried out for various heliophysical conditions it was found that observed value of mentioned ON-OFF ratio is 6-8 dB less than expected one. The possible explanation of the fact could be taken out as an influence of photoelectric and thermal noises at the receiver input. The interference of EMC nature is not excepted too. Also some results of an experiment to calibrate of RAD2 receiver in 1 MHz range by Galaxy radio background are presented in the report.

A QUARTER CENTURY AFTER THE IN-SITU OBSERVATIONS OF
· COMET P/HALLEY BY THE APV/V WAVE EXPERIMENT ABOARD
VEGA 1 AND 2. THE MUTUAL IMPEDANCE PROBE OF THE ROSETTA
MISSION WILL INVESTIGATE COMET WIRTANEN.

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The high-frequency plasma-wave analyser. APV-V, measured intense E-field signals when the VEGA 1 and 2 spacecraft went into the coma of comet P/Halley. Several discontinuities were detected at cometocentric distances lying between 150,000 km and 10,000 km. They have been interpreted as dust jet crossings and among other parameters the average terminal velocity of dust particles, having mass between 10^{-11}g and 10^{-14}g, and nucleus rotation period have been derived from these observations. The Mutual Impedance Probe, MIP, is part of the ROSETTA Plasma Consortium, RPC. It will investigate the distribution of local aeronomical parameters, such as the electron density, temperature, and velocity, in the inner coma of comet Wirtanen. In particular the regions inside the contact surface will be probed for the first time. In addition, MIP will analyse the E-field component of natural waves from 10 kHz up to 3.5 MHz and monitored dust impacts and ionized outgassing products. The MIP measurements are essential to study the ionization, thermalisation and expansion of the cometary atmosphere as a function of the nucleus activity all along the ROSETTA Orbiter mission.

DIAGNOSING THE MAGNETOSPHERIC PLASMA STRUCTURES
USING RELATIVISTIC ELECTRON DATA

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The key region in the magnetosphere is a transition between dipole field lines and the field lines extended to the magnetospheric tail. This region

defines the position of trapped radiation boundary, discrete auroral forms, auroral electrojets, field-aligned currents (Tverskoy, 1982). Formed here, the intensity maximum of storm-time injected relativistic electrons may be used as a diagnostic probe of the above region position in the storm maximum. The behavior of simultaneously measured both near-equatorial ring current ions and relativistic electrons, in the course of strong magnetic storm, is analyzed. As appears, the injection of relativistic electrons into the slot region is occurred on time scale ~1 hour when the extremely low latitude position of auroral electrojets is reached and the ring current becomes more symmetrical. An extreme storm-time low-latitude position of the west electrojet center (for amplitudes of D_{st}-variation up to 600 nT) is shown to be in a good agreement with the empirical dependence of L_{max} position on Dst-variation amplitude. It is supposed the trapped radiation boundary collapses in the course of storm main phase down to $L \sim L_{max}$.

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PLANETARY BOW SHOCK MODEL: GENERALIZATION FOR NON FIELD ALIGNED MHD FLOW, APPLICATION FOR MARTIAN BOW SHOCK MOTION STUDY

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An analytical empirical bow shock model applicable for a wide range of sonic Mach numbers ($1 < M_s < \infty$ in hydrodynamic approximation) is

generalized for a case of non field aligned MHD flow. Bow shock position is determined as a function of Alfvenic M_a and sonic M_s Mach numbers, and of the angle between the subsolar shock normal and the upstream magnetic field. The model explains unusually weak dependence of the Martian terminator bow shock position on the solar wind ram pressure revealed by Phobos 2, and unusually distant shocks observed at Venus by PVO. Additional verification of the model comes from case by case study of Martian bow shock and magnetopause crossings.

IDENTIFICATION OF PLASMA REGIMES IN THE MIDDLE TAIL USING INTERBALL-1 DATA.

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The extension of the identification method used in the Geotail data processing (Eastman et al., 1998a,b) is proposed. Data obtained by magnetometer MIF-M and energetic particle analyzer DOK-2 in the spatial region of $X_{gsm.} \le 5R_e$ during October-November 1996 are used in the study. Structure and fluctuation levels of the magnetic field, average values of proton and electron fluxes are analyzed. Distinctions among the tail plasma regimes (lobes, central plasma sheet, and boundary layers) are shown and qualitative experimental criteria are proposed. Comparison with the empirical models for several time intervals is made.

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SOLAR WIND AND IMF PARAMETERS AT THE EARTH'S ORBIT
DURING THREE SOLAR CYCLES

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We have used the solar wind and IMF NSSDC OMNIWeb data set (1964 -
1996) to study long-term variations. Data base contains about 250,000
hourly averaged values of the solar wind velocity, density, temperature and
magnetic field strength and vector components. Three-monthly running
averaged values of all these parameters, as well as solar and geomagnetic
indexes were calculated and intercompared during different phases of the
20, 21 and 22-d solar cycles. General trends and solar cycle variations are
evaluated and compared with published results. Points of correspondence
and differences are noticed. New features in the density and the
temperature are found. Mass, momentum, energy and enthalpy flux
densities; thermal, dynamic and magnetic pressures; plasma beta; Alfven
speed, adiabatic sound speed; sonic, Alfvenic, and magnetosonic Mach
numbers also show specific variations. Possible interpretations are
suggested using the concepts of the magnetically open, closed and
intermittent types of the solar wind sources. We conclude that the
observed variations at the Earth's orbit are related to the space-time
evolution of the mentioned sources on the Sun and their different
proportions during different solar cycle phases. Magnetic fields of the Sun
and the heliospheric current sheet play the mediating role.

THE MODEL MAGNETIC CONFIGURATION OF THE EXTENDED
SOLAR CORONA IN THE SOLAR WIND FORMATION REGION

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The coupling between small and large scale structures and processes on
the Sun and in the heliosphere is important in the relation to the global
magnetic configuration. The analytical model of the magnetic field
configuration is constructed as a superposition of the three sources: 1) a
point magnetic dipole in the center of the Sun, 2) a thin ring current sheet

with the azimuthal current density $j_\varphi \sim r^{-3}$ near the equatorial plane and 3) a magnetic quadrupole in the center of the Sun. The model reproduces, in an asymptotically correct manner, the known geometry of the field lines during the declining phase and solar minimum years near the Sun (the dipole term) as well as at large distances in the domain of the superalfvenic solar wind in the heliosphere, where the thin current sheet dominates and $|B_r(\vartheta)| = const$ according to Ulysses observations. The model with the axial quadrupole term is appropriate to describe the North - South asymmetry of the field lines. The model may be used as a reasonable analytical interpolation between the both extreme asymptotic domains to the region of the intermediate distances $(1 - 10)R_\odot$ when considering the problems of the solar wind dynamics and cosmic ray propagation theories.

WHAT CAN WE KNOW ABOUT PROCESSES OF FORMATION AND DYNAMICS OF DIFFERENT TYPES OF SOLAR WIND STREAMS ON THE BASIS OF PROTON AND ALPHA OBSERVATIONS ?

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Different average values and dependences of helium parameters (relative abundance n_α/n_p, alpha and proton velocity difference $\delta V = |V_\alpha|-|V_p|$, and temperature ratio T_α/T_p) on bulk parameters in different types of solar wind streams studied on the basis of the PROGNOZ 7 selective plasma measurements of alpha-particles and protons allow us to suggest that processes of formation of solar wind streams and their dynamics in the interplanetary space are different. Helium abundance increases with increasing wind velocity in quasi-stationary streams from 1.7% in the heliospheric current sheet (HCS) up to 4.7% in the coronal streamers (CS) and 6.6% in the coronal holes (CH). Maximum value of $n_\alpha/n_p \approx 10.5$ % is observed in coronal mass ejections (CME) and intermediate between HCS and CS value 3.4% in the shocked plasma. Helium abundance increases with increasing mass flux and density in streams from CHs and decreases in streams from CSs. No evidence has not been obtained that the processes of alpha-particle acceleration differ from each other in streams from CSs and CHs but they differ from the one in the HCS. In contrast to

processes of acceleration the processes of alpha-particle heating in streams from CHs and CSs·are suggested to differ from each other but they may be the same in streams from CSs and HCS. The value of alpha-particle heating in streams from CHs increases with increasing absolute value of velocity difference of alpha-particles and protons.

SOLAR WIND AND MARTIAN MAGNETOSPHERE INTERACTION WITH GAS-DUST DISK OF PHOBOS

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According to the magnetic field and plasma data returned by PHOBOS-2 s/c some solar wind distortions of solitary type were revealed at the Phobos orbit in the end of March 1989. These disturbances are identified as an evidence of solar wind interaction with gas-dust torus of Phobos. The dominated increase of the transversal magnetic field component is caused by the generation of the current system in the plane of thin gas-dust disk of Phobos. The current generation is maintained by the ambipolar electric field aroused as result of solar wind ions absorption by the negatively charged micron dust grains and following ambipolar diffusion in the subsolar region of Phobos dust disk. The plasma cavity in the close vicinity of Phobos (at the distance of 300-400 km) is formed as result of such an interaction. Some features of this cavity are similar to the plasma cavity in the lunar wake. In the collisionless plasma the solar wind ions penetrating in the cavity move only along magnetic field lines. Starting on March 21, 1989 the PHOBOS-2 s/c crossed regularly the distant edge of gas-dust disk of Phobos but the effect of solar wind interaction was detected by the magnetometer and plasma detector only few times. The main parameter which affects the solar wind ions absorption is the negative electrostatic charge acquired by the micron dust grains when they immerse into the Martian plasma sheet on the way along the Phobos orbit. The episodic character of the unusual solar wind distortions detected by the PHOBOS-2 s/c more likely is caused by the different duration of the gas-dust disk immersion into the plasma sheet. Apparently the maximum permissible interval of 1.4 hour will suffice that the micron size dust grains can acquire the negative charge and maintain it in 2-3 hours.

NONLINEAR MECHANISM OF THE LOWER-HYBRID WAVES GENERATION IN THE MAGNETOSPHERE.

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The data from satellite observation show that interaction between the lower-hybrid waves and whistlers exists (Brice & Smith, 1984; Scarf et al., 1972). The new nonlinear mechanism of lower-hybrid wave generation with the aid of whistlers has been investigated in present paper. In the capacity generation mechanism is considered the parametric instability (whistler wave disintegrate on the lower-hybrid wave and the kinetic Alfven wave) in the magnetized plasma with small plasma parameter

$\beta' = 8\pi nkT/B^2 \ll 1$. Two-fluid magnetohydrodynamics is used for the description of waves nonlinear parametric interaction. The nonlinear dispersion equation for the coupling waves is found. We found the instability growth rate ν and threshold value for amplitude of the pump wave. The instability growth rate ν is proportional to the electron inertia length. The investigation shows that taking into account the kinetic effects in the Alfven waves (the electron inertia length) essential for parametric interaction of waves. We found also what the instability growth rate $\nu \approx 10^3 \, c^{-1}$. It's pointed out that this process is very effective. Consequently, we consider this parametric instability as mechanism generation of the lower-hybrid waves in the magnetosphere of the Earth.

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F.L.Scarf, R.W. Fredrics, E.J. Smith, et al., OGO-5 observations of LHR noise emissions and whistlers near the plasmapause at several Earth radii during a large magnetic storm, J.Geophys.Res., **77**, No.10, 1776-1793, 1972.

SOLAR WIND STRUCTURE DYNAMICS BY MULTIPOINT OBSERVATIONS

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Solar wind plasma (and partly simultaneous magnetic field) cross-correlation of data from several spacecraft were analyzed in detail:
- from IMP 8 and ISEE 3 for periods near the 1981 solar minimum;
- from IMP 8, WIND and INTERBALL-1 for periods near the 1996-97 solar minimum.

The correlations were examined as a function of the spatial separation of the spacecraft (along the X_{se} axis and in the perpendicular plane) and of the interplanetary (solar wind density, bulk speed, ion flux, IMF value and direction, and their variations). It was shown that for 6-hour intervals the correlation coefficient is equal in average to 0.6-0.7 and the solar wind structures' persistent time is large enough. Investigation of the distribution of the lags for maximum correlations allows us to estimate the average inclination of solar wind disturbances' fronts.

EVIDENCE OF THE EXPLOSIVE RECONNECTION IN THE MAGNETOTAIL INTERBALL OBSERVATIONS OF THE ENERGETIC PARTICLE SPECTRA

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Energetic particle population in the tail of the Earth's magnetosphere has been the subject of intensive experimental and theoretical studies during

last thirty years. Nevertheless there is no good understanding of the mechanisms by which particles are accelerated up to 1 Mev energies. New and more detailed data on the spectra of energetic protons and electrons obtained in a course of DOK experiments (Interball project) allow a comparison between the shape of spectra and predictions of different particle acceleration models. The 56-point spectra were measured in intervals of 20-800 keV for protons and 30-400 keV for electrons with the energy resolution of 5-9 Kev. We made calculations of particle spectra accelerated in the vicinity of the magnetic field X-line by the current sheet disruption. While both protons and electrons are accelerated by induction electric fields the dynamics and mechanism of their acceleration occur quite different. The calculations give power law type spectra for protons and Maxwell or exponentional one for electrons. The experiment confirmed this result and showed that such types of spectra were observed in 74% of cases for protons and in 64% for electrons. We select for comparison experimental spectra measured in the plasma sheet in intervals of tens of minutes when particle fluxes were stable enough. It can be assumed that these spectra resemble those in the source. We also suggest a model explaining the permanent difference in the spectrum slope of the earthward and tailward moving protons. A mechanism related to the velocity filter effect could account for the hardening of reflected (tailward moving) populations in comparison with those originally accelerated.

A LOW LATITUDE MAGNETOMETER CHAIN IN CHINA IN THE FRAME OF THE MERIDIAN PROJECT

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MERIDIAN is a 120° east ground based Multi-station and Multi-instrument project proposed in China. The Department of Experimental Space Research of the Space Research Institute in Graz in cooperation with IGPP/UCLA/USA and CSSAR/Beijing/CHINA has developed variometers

for magnetic field observations along this MERIDIAN chain. The variometer (CHIMAG) is a fluxgate magnetometer especially for earth field variation and pulsation measurements. Two variometer stations have been installed in Beijing (40° N) and Hainan (19° N), respectively. Three more will be installed in 1998/1999. In this paper we will present the design and the scientific objectives of the CHIMAG as well as the results of the first observations.

COLLECTIVE HEATING OF THE UPPER HIGH LATITUDE IONOSPHERE

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Auroral electron beams unstable on the Cherenkov resonance in the ionospheric F_2 region are stabilized by the monotonous large-scale inhomogeneity of the plasma density along their path from acceleration area to the ionospheric E region. The collective dissipation of beam energy is possible only in area of small gradients of the plasma density that always takes place near the F_2 region maximum. Under certain conditions the auroral thermal wave is formed in this area, which is the region of high-frequency plasma turbulence moving towards the electron beam. The registration of high electron and ion temperatures, their gradients, decametric radiation with the fast decrease of frequency, and also high level of high-frequency plasma waves is the direct outcome of the auroral thermal wave existence. Small-scale inhomogeneities of the plasma density with amplitude $\delta n/n \sim 0.1$ and size about 10 km have been often registered in the high latitude ionosphere. The numerical calculations have shown these small-scale inhomogeneities also result in local failures of the electron beam stabilization and collective dissipation of its energy on these regions. It is necessary to note, that the region of the small-scale inhomogeneity on the altitudes about thousand kilometers from the Earth will be collective heating region even for those beams which growth rate is insufficient for the waves generation in more dense plasma of the F_2 region maximum.

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